

INTRODUCTION

This paper provide a checklist, illustrated keys, range maps and summarized information on the biology and ecology of the amphibians of northwest Africa. The geographic area covered includes Morocco (including Western Sahara), Algeria, Tunisia, and Libya. The regions of Mauritania, Mali, Niger, and Tchad located north of 20° longitude are included. Saharan mountains, specially the Tibesti, are probably the least known regions in the area. Pellegrin (1936) and Scortecci (1940) mention the presence of *Bufo* sp. and *Rana* sp. in the Tibesti massif. I could not locate specimens of amphibians from these mountains in museum collections. Major works of the amphibians of the region are those of Pasteur and Bons (1959) on Morocco, Doumergue (1901) on Algeria and Scortecci (1936) on Tripolitania (Libya). Information on newts is found in Thorn (1968). For a more comprehensive bibliography of the area see Busack (1976). Information on the amphibians of Egypt is found in Marx (1968).

To prepare distribution maps I examined specimens of the following institutions: American Museum of Natural History, New York (AMNH); British Museum (Natural History), London (BMNH); California Academy of Sciences, San Francisco (CAS); Carnegie Museum of Natural History, Pittsburgh (CM); Field Museum of Natural History, Chicago (FMNH); Los Angeles County Museum of Natural History, Los Angeles (LACM); Museo Civico di Storia Naturale, Genoa (MSNG); Museum d'Histoire Naturelle, Geneve (MHNG); Museum of Comparative Zoology, Harvard (MCZ); Museum of Vertebrate Zoology, Berkeley (MVZ); Museo Zoologico della Specola, Firenze (MZUF); National Museum of Natural History, Washington DC (USNM); Naturhistorisches Museum, Basel (NHMB); Naturhistorisches Museum, Wien (NMW); Naturhistoriska Museet, Goteborg (NHMG); Rijksmuseum van Natuurlijke Historie, Leiden (RMNH); Senckenberg Museum, Frankfurt (SMF); Swedish Museum of Natural History, Stockholm (NHRM); University of Michigan Museum of Zoology, Ann Arbor (UMMZ); Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn (ZFMK); Zoologisches Staatsammlung, München (ZSM).

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Order Caudata

Also called Urodela, so titled because they have long tail, long body and distinct body regions. The front limbs are similar in size to the hind ones. They lack external ear openings. Both adults and their larvae are carnivorous. Fertilization is internal but there is no copulation. Males deposit a gelatinous capsule - the spermatophore - which contain the spermatozoa. The female places this capsule in her cloaca. This generally takes place in water. The larvae have external gills.

Of the approximately 392 species alive today, only three are found in Africa and their distribution is limited to the extreme northwest. The three species belong to the family Salamandridae.

Family Salamandridae

Some 55 species currently live in Europe, Asia, North Africa, and North America. Generally nocturnal with cryptic habits. *Salamandra salamandra* is terrestrial and lives in wooded areas with relatively high humidity. This species does not lay eggs and give birth to well-developed larvae. It is found in Europe and Southwest Asia as well as North Africa.

The two species of *Pleurodeles* are terrestrial with the exception of the reproductive season, which is spent in water. One of the species - *P. poireti* - is endemic to the north of Algeria and Tunisia, while the other - *P. waltl* - is also found in the Iberian Peninsula.

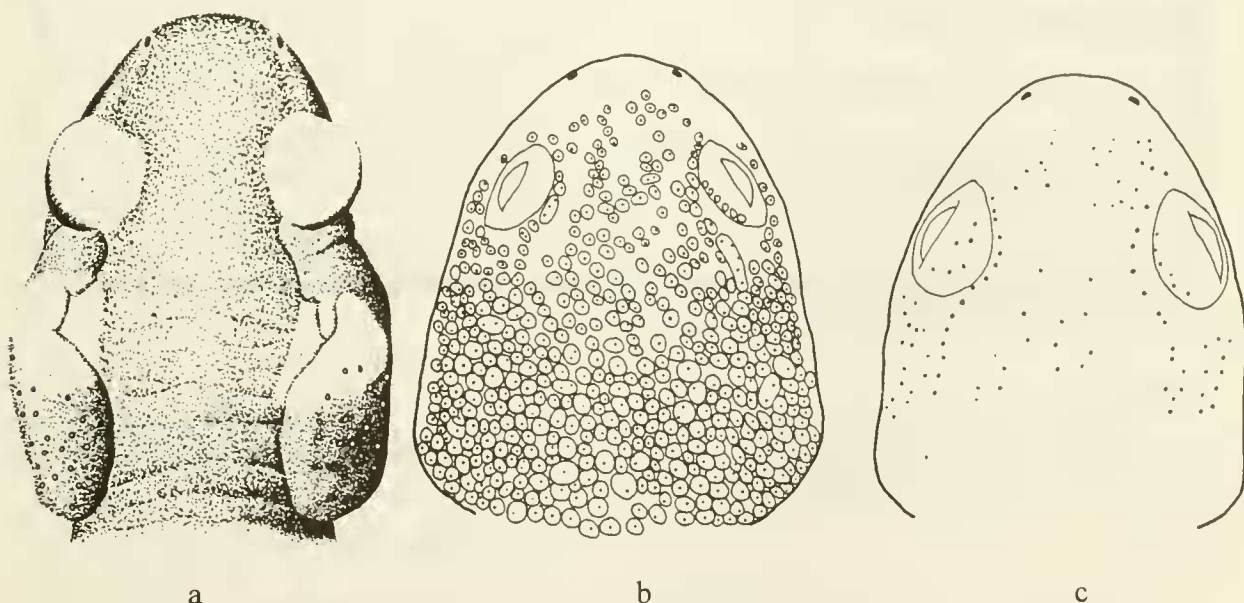


Fig. 1. Dorsal view of the head of *Salamandra salamandra* (a), *Pleurodeles waltl* (b), and *Pleurodeles poireti* (c).



Fig. 2. Position of palatal teeth and choanae in *Pleurodeles poireti* (a) and *Pleurodeles waltl* (b).

Key to the salamanders

1. Smooth skin. With paratoid glands on the back of the head (Fig. 1a). Tail round ***Salamandra salamandra***
- . Rough skin. With no paratoid glands (Figs. 1b,1c). Tail laterally compressed.....2
2. The palatal teeth extend anterior of the choanae (Fig. 2b). Large size. Conspicuous gular fold. A row of 8 to 10 distinct, ochre or white warts on each side..... ***Pleurodeles waltl***
- . The palatal teeth do not extend beyond the choanae (Fig. 2a). Small size. Not very conspicuous gular fold. With no warts on the sides..... ***Pleurodeles poireti***

Pleurodeles poireti (Gervais, 1835) (Figs. 1c, 2a, 3)

Triton poireti Gervais, 1835. Bull. Soc. Sci. Nat. France, 6: 113.

Molge poireti: Boulenger, 1891:162. Doumergue, 1901:381.

Glossoliga hagenmuelleri Lataste, 1881. Le Naturaliste, 1881:371.

Molge hagenmuelleri: Boulenger, 1891:162. Doumergue, 1901: 385.

Pleurodeles poireti hagenmuelleri: Wolterstorff, 1905:263.

Pleurodeles poireti: Pasteur, 1958:161.

Diagnosis

Small-bodied species. No yellowish or orange-coloured warts on its sides. Front of vomeropalatine tooth rows not at or behind level of choanae.

Size

Total lengths to 176 mm.

Description

Head not flattened, as long as it is wide. Body round in cross-section, somewhat depressed middorsally. Conspicuous

gular fold. Has no prominent warts on the sides. Tail laterally compressed, as long or longer than the head and body. No tail crests. Warty skin except on the abdomen. Males with poorly developed black keratinous pads on inner side of forelimbs when breeding.

Variation

Variations between populations of Algeria and Tunisia have been described which would affect size, tail proportions, gular fold, jaw curvature and toe shape. This variation seems to be of an individual type and subspecies *hagenmuelleri* Lataste, 1881 is not recognized presently.

Ecology

Unknown.

Biology

The only available data were observed in captivity. Copulation is similar to that of *P. waltl*.

Distribution

Northern Algeria and Tunisia (Fig. 3).

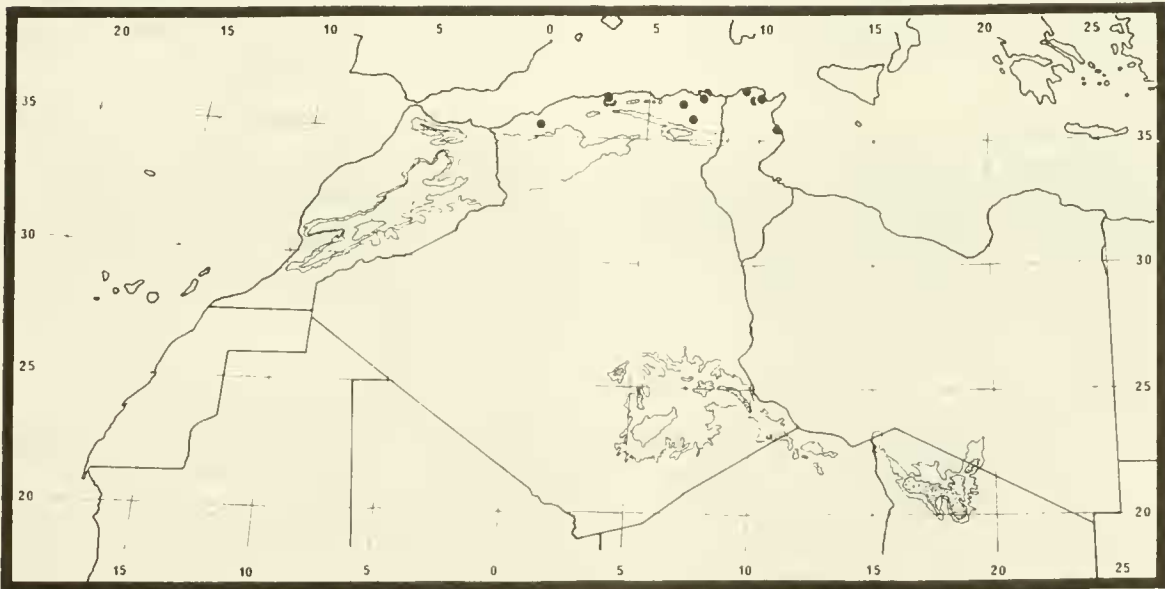


Fig. 3. Distribution of *Pleurodeles poireti*.

Bibliography

Pasteur (1958), Thorn (1968), Wolterstorff (1905).

Pleurodeles waltl Michahelles, 1830 (Figs. 1b, 2b, 4)

Pleurodeles waltl Michahelles, 1830. Isis von Oken, 23: 195.

Pleurodeles waltlii Boettger, 1874.

Molge waltlii: Boulenger, 1891:162. Doumergue, 1901:389.

Pleurodeles waltli: Pasteur and Bons, 1959:80. Thorn, 1968: 124.

Diagnosis

Large bodied, with wide, depressed head. Head, body, tail and extremities covered with small tubercles. Eight or 10 ochre or whitish warty protuberances on each side. Tail strongly compressed laterally with reduced crests. Front of vomeropalatine tooth rows beyond level of choanae.

Size

Total lengths to 252 mm in males and 242 mm in females.

Description

Strongly depressed head, slightly longer than wide; Round snout; small, dorsolateral eyes. Conspicuous gular fold. Body, except abdomen, covered with tubercles. Tail laterally compressed; its length approximately equal snout-vent length. Tail tip blunt. Dorsal and ventral crests on tail, somewhat more prominent in males during reproductive period. Males have black keratinous pads on the inner side of the forelimbs when breeding. Each side of body with a series of ochre or whitish protuberances. During breeding season, crests turns orange. Cloacal opening similar in both sexes; pappilate appeared in males and ridged in females. Coloration olive green, brownish or yellowish grey. Venter yellowish or orange-coloured with scattered dark marks.

Variation

Adults from Morocco are smaller than those from the Iberian Peninsula. Also when breeding, crest development is less and of shorter duration than in the Iberian ones. The tail is shorter than or the same as snout-vent length in metamorphic individuals and longer in adults. Individual or geographic variation in Morocco has not been described.

Ecology

This species live from sea level to 1100 m. Its basic diet is crustaceans. It spend the summer under stones and in fissures in the mud at depths of 30-50 cm and is aquatic during the reproductive season. Between December and January, young specimens are observed under stones or in the mud. They have been found in caves at depths of 60-70 m.

Biology

They breed in temporary ponds and slow moving waters. Active adults can be observed on rainy nights. Larvae are observed from the end of February onwards. Larvae reach a total length of 115 mm. Metamorphs collected on May measured from 31 to 60 mm SVL. Metamorphs are found from May until the end of October. Larvae are larger at the end of the season. Reproductive individuals measure a minimum total length of 97 mm.

Distribution

Western Morocco (Fig. 4).

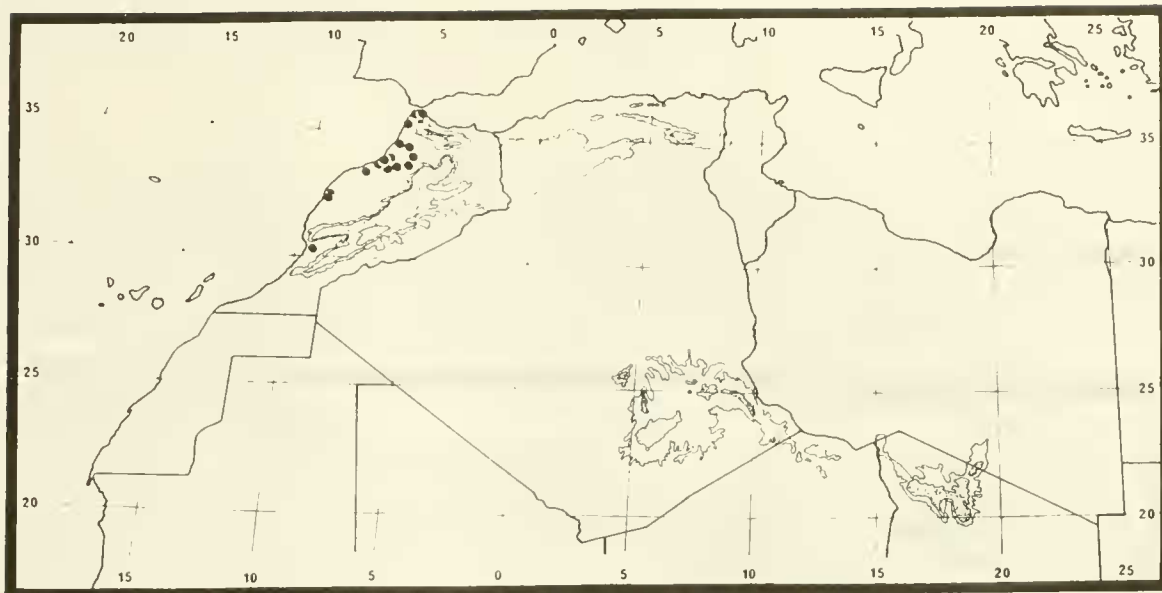


Fig. 4. Distribution of *Pleurodeles waltl*.

Bibliography

Dorda (1984), Pasteur (1958), Pasteur and Bons (1959), Thorn (1968).

Salamandra salamandra algira Bedriaga, 1883 (Fig. 1a, 5)

Salamandra maculosa: Boulenger, 1891:161. Doumergue, 1901:370.

Salamandra maculosa var. *algira* Bedriaga, 1883. Arch. Naturg., 49:252. Pasteur and Bons, 1959: 93. Thorn, 1968:161.

Salamandra salamandra algira: Eiselt, 1958:133.

Diagnosis

Black with yellow spots. Kidney-shaped paratoids on the upper part of the head. Smooth skin with no tubercles.

Size

Total lengths to 226 mm.

Description

Narrow, somewhat depressed head with rounded snout and conspicuous paratoids. Gular fold present. Subcylindric tail, somewhat laterally compressed. Smooth dorsum with parasagittal and lateral row of pores on each side. Cloacal opening similar in both sexes, lips somewhat larger in males. Background color blackish with yellow spots variable in form and arrangement.

Variation

The North African populations are characterized by their relatively small size, and a long and narrow tail, and a short, narrow, flattened head with short, narrow paratoids. Pattern varies from two rows of rather long marks on the dorsum to a single row of circular marks or to scattered, isolated spots.

The venter is black, sometimes with yellow spots. The subspecies *algira* Bedriaga, 1883 is applied to these populations.

Ecology

It occurs to 2010 m in Morocco, 1550 m in Algeria, and 1500 m in Tunisia. In Algeria it lives in *Cedrus* and *Quercus* woods. During the day it is found under stones and among roots. It lives near streams. It has been observed in caves. Groups of 15 to 20 active salamanders have been seen in November in Algeria.

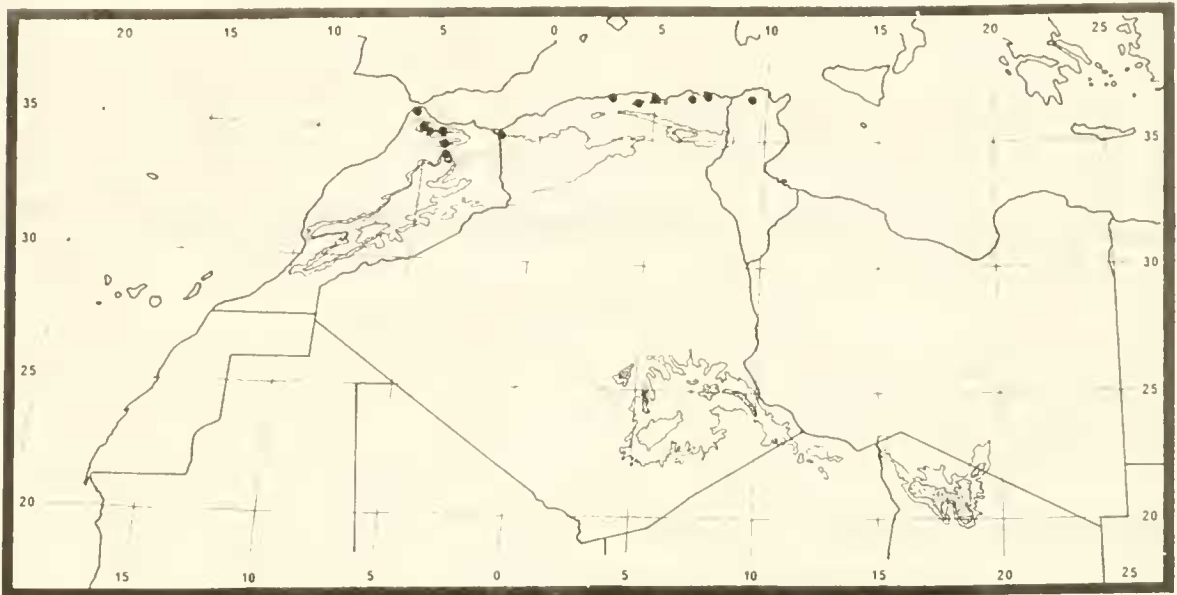


Fig. 5. Distribution of *Salamandra salamandra*.

Biology

Birth of 16 larvae were reported in May in Algeria. A female caught in December in Morocco had 15 larvae of 27 mm in total length. Towards the end of February larvae in the water in the Rif mountains, and recently metamorphosed individuals under stones were observed.

Distribution

Northern Morocco, northern Algeria, and northern Tunisia (Fig. 5).

Bibliography

Bons (1972), Boulenger (1891), Dorda (1984), Doumergue (1901), Eiselt (1958), Galán (1931), Geniez and Soto (1994), Pasteur and Bons (1959), Thorn (1968).

Order Anura

There are approximately 3967 species of frogs and toads. Their body is short and without tail. Hindlimbs are larger than forelimbs. Many anurans have a conspicuous tympanum and use vocalizations to attract mates.

Anurans are represented in northwestern Africa by five families and 13 species.

Key to Anurans

1. With adhesive circular pads on tips of fingers and toes (Fig. 13).....***Hyla meridionalis***
- . Lacking adhesive pads on tips of fingers and toes.....2
2. Pupil vertical.....3
- . Pupil not vertical.....4
3. Black keratinous spade (modified metatarsal tubercle) present. Two relatively small and inconspicuous palmar tubercles. Toes with webbing (Fig. 11).....***Pelobates varaldii***
- . Lacking metatarsal spade. Three palmar tubercles. Toes without webbing (Fig. 7).....***Alytes obstetricans***
4. Skin more or less smooth. No paratoid glands5
- . Skin with warts. Conspicuous paratoid glands.....8
5. Pupil rounded. Subarticular tubercles lacking (Fig. 9).....***Discoglossus pictus***
- . Pupil horizontal. Subarticular tubercles present.....6
6. With dorsolateral glandular ridge on body.....***Rana saharica***
- . Without dorsolateral glandular ridge on body.....7
7. Large inner metatarsal tubercle, larger than toe next to it (Fig. 31). Tympanum indistinct, its diameter half that of the eye. Webbing of the toes slight (Fig. 31)..***Tomopterna cryptotis***
- . Small inner metatarsal tubercle, much smaller than toe next to it (Fig. 29). Tympanum conspicuous, diameter nearly equal to that of eye. Webbing of toes extensive (Fig. 29)..***Hoplobatrachus occipitalis***
8. With tarsal spade. Large inner and outer metatarsal tubercles, spade-shaped (Fig. 25).....***Bufo pentoni***
- . Without tarsal spade. Metatarsal tubercles not spade-shape.....9
9. Without tarsal fold. Dorsal colour uniformly brown.***Bufo bufo***
- . Tarsal fold present. With spots on dorsum.....10

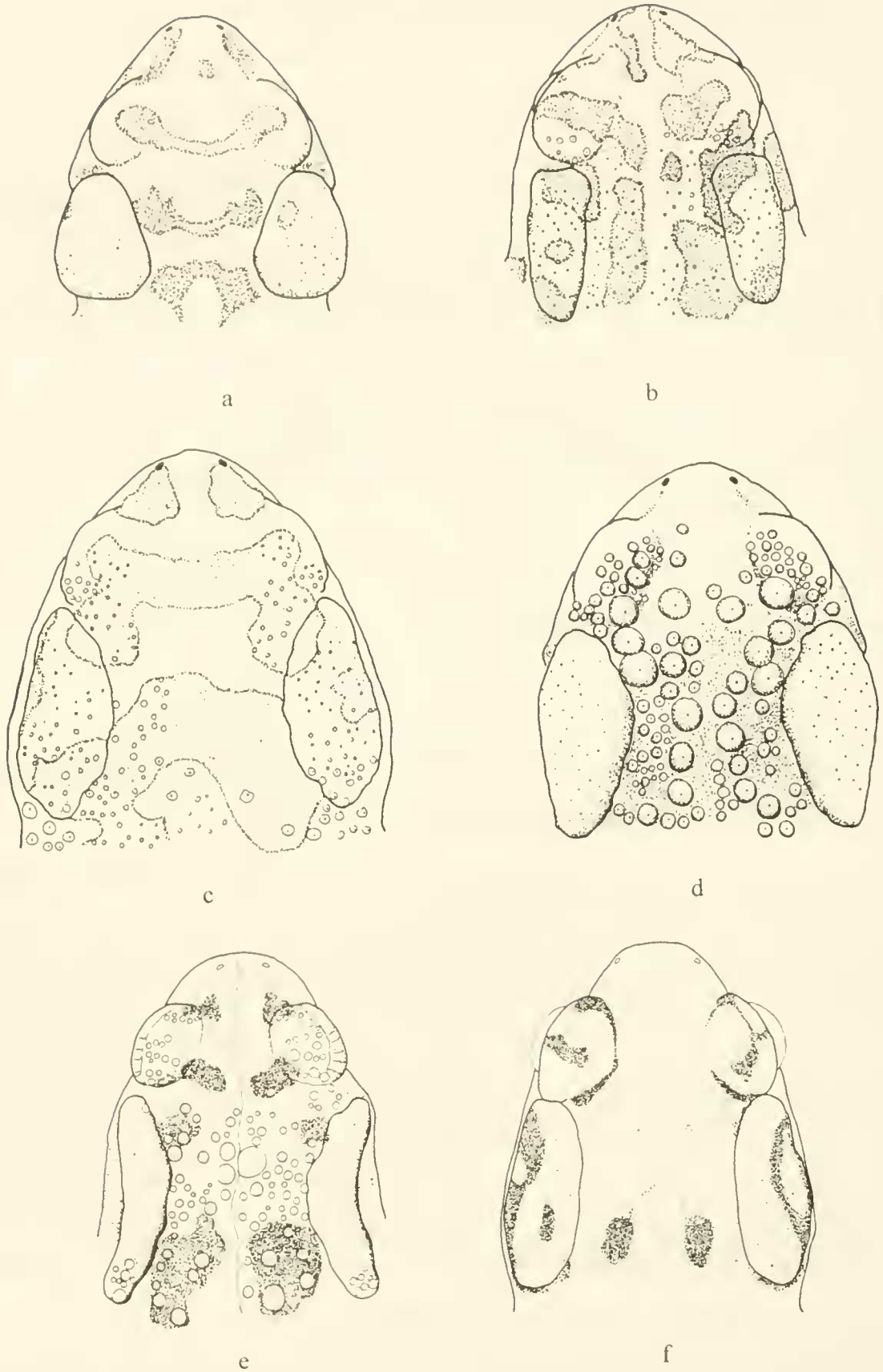


Fig. 6. Dorsal view of head of *Bufo brongersmai* (a), *Bufo viridis* (b), *Bufo mauritanicus* (c), *Bufo bufo* (d), *Bufo xeros* (e), and *Bufo pentoni* (f).

10. With green spots on the dorsum.....11
 -. With brown spots on the dorsum.....12
11. Paratoid glands elongated (Fig. 6b). Distal subarticular tubercle of fourth toe single (Fig. 21).....**Bufo viridis**
 -. Paratoid glands rounded (Fig. 6a). Distal subarticular tubercle of fourth toe double.....**Bufo brongersmai**
12. Distal subarticular tubercle of fourth toe double (Fig. 19). Numerous irregular spots on dorsum.....**Bufo mauritanicus**
 -. Distal subarticular tubercle of fourth toe single (Fig. 23). Six pairs of roughly square-shaped spots on head and dorsum.....**Bufo xeros**

Family Discoglossidae

This family includes some sixteen species found in Europe, Asia, and North Africa. The majority are terrestrial. In general they deposit their eggs in the water except in the genus *Alytes*. The species of *Alytes* exhibit parental care. Amplexus takes place on the ground, and the female transfers the eggs to the male who sticks them to his hindlimbs. He carries them for a period of time, then takes them to water for the larvae to hatch.

Two species live in North Africa. *Discoglossus pictus* also occurs on the island of Sicily, and *Alytes obstetricans* occurs in SW Europe.

Alytes obstetricans Laurenti, 1768 (Figs. 7-8)

Alytes obstetricans: Galán, 1931:362.

Alytes (obstetricans) maurus Pasteur and Bons, 1962. Bull. Soc. Zool. France, 87 (1):71.

Diagnosis

Small toad. Pupil vertical. Paratoid glands small and not kidney-shaped. Lacking interdigital membranes and subarticular tubercles. Three palmar tubercles present. Skin with small warts.

Size

Snout-vent lengths to 39 mm.

Description

Wide, somewhat flattened head, with a round snout that is somewhat pointed at its tip. Circular tympanum with a diameter 0.67- 0.79 times horizontal diameter of eye. Long, slender digits. First digit of the hand shorter than second, second and fourth digits subequal and shorter than third. Three palmar

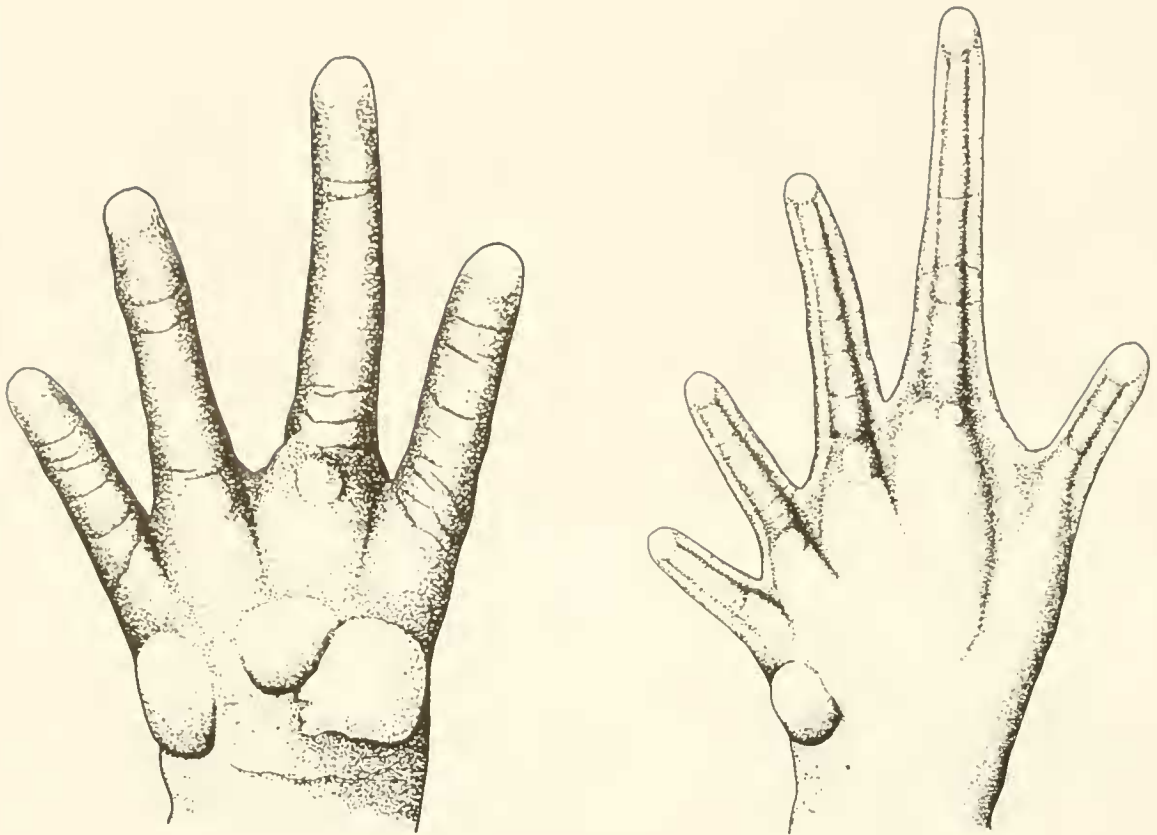


Fig. 7. Palmar view of hand (left) and plantar view of feet (right) of *Alytes obstetricans* (USNM 196383).

tubercles; small inconspicuous tubercle at the base of each digit. Hindlimbs short with long toes, lacking subarticular

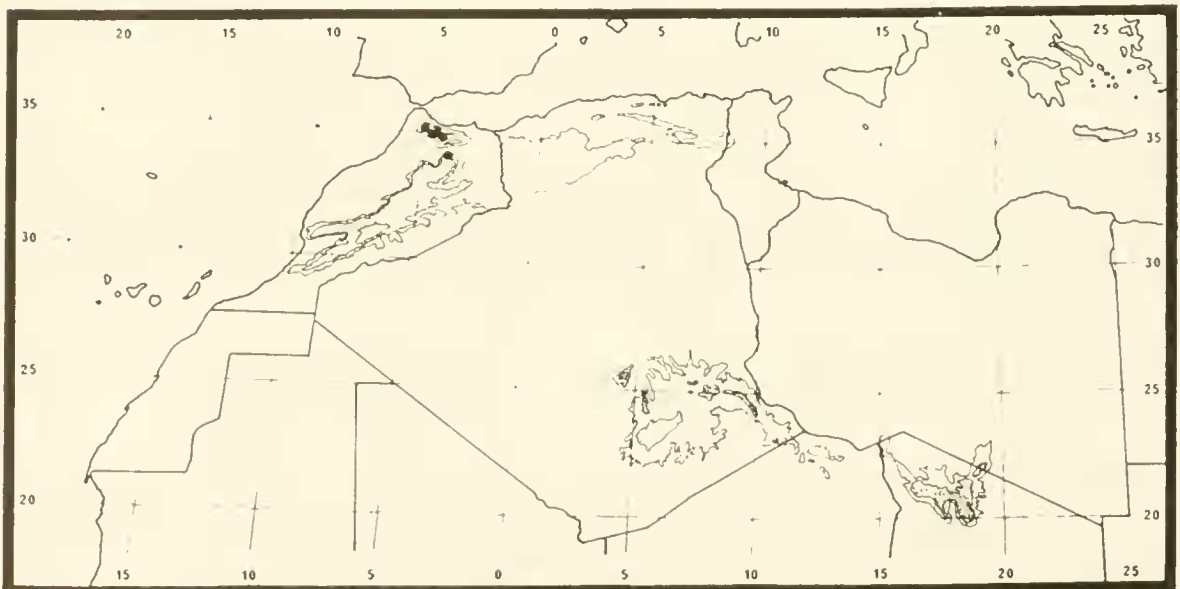


Fig. 8. Distribution of *Alytes obstetricans*.

tubercles. Inner metatarsal tubercle present. Dorsum and flanks covered with small warts. Paratoid gland above the tympanum, extending posterior as a series of small glands on each side of the body. Skin of the belly granulated. Dorsal colour greyish brown with small green patches on the head, back, and upperparts of the limbs. Venter whitish. Iris golden.

Variation

Alytes obstetricans is smaller in Morocco than Europe; also the body is slender, and the digits longer and thinner. No individual or geographical variation within Morocco has been described.

Ecology

Its ecology is little known in North Africa, but it has been found between 850 and 1500 m altitude.

Biology

Tadpoles have been reported in March and August and recently metamorphosed individuals in October.

Distribution

Rif and nearby Middle Atlas mountains, Morocco (Fig. 8).

Bibliography

Arntzen and Szymura (1984), Galán (1931), Libis (1985), Mellado and Mateo (1992), Pasteur (1961), Pasteur and Bons (1959, 1962).

Discoglossus pictus scovazzii Camerano, 1878 (Figs.9-10)

Discoglossus pictus: Boulenger, 1891:160. Pasteur and Bons, 1959: 100.

Discoglossus scovazzii Camerano, 1878. Att Acc. Torino, 13: 548.

Discoglossus auritus Heron-Royer, 1889. Bull. Soc. Angers, 1889:177.

Discoglossus pictus scovazzi: Capula et al., 1985:71.

Diagnosis

Frog-like, with pointed snout and round pupil. No subarticular tubercles. Tympanum inconspicuous. Dorsum with dorsolateral fold on each side, usually extending only from eye to shoulder. Back with irregular dark spots or longitudinal stripes.

Size

Snout-vent lengths to 70 mm in males and 68 mm in females.

Description

Head strongly depressed, with pointed or round snout. Fingers short, first shortest and third longest; second and fourth of equal length. Three palmar tubercles and no subarticular tubercles. Hindlimbs relatively long, with slight

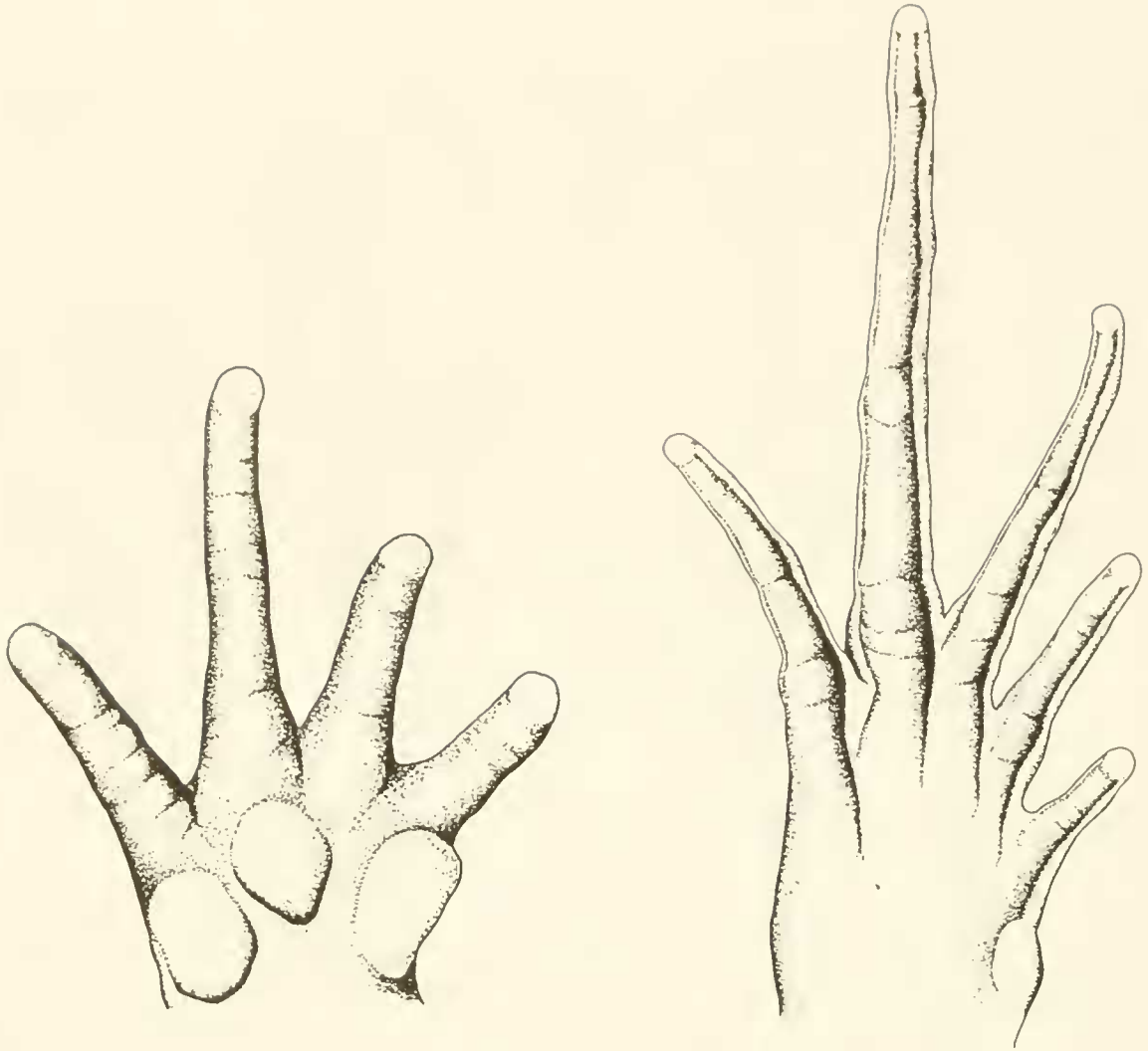


Fig. 9. Palmar view of hand (left) and plantar view of feet (right) of *Discoglossus pictus* (MVZ 186138).

webbing between toes. Small inner metatarsal tubercle present. Vomerine teeth in straight or slightly curved series, narrowly separated medially. Tongue disc-shaped. Skin smooth with small glands on dorsum.

Dorsal colour brownish, olivaceous, or grey. Dark temporal band from snout to tympanum. On back, dark spots of irregular shape and size, occasionally forming longitudinal stripes. Iris golden or bronze coloured. Venter whitish or yellowish, sometimes olivaceous red. Males with blackish corneous excrescences on the throat, belly, and limbs.

Variation

The North African populations are considered conspecific with those from Sicily, although they are sufficiently differentiated to be included in the subspecies *scovazzii* Camerano 1878. There is local variation in the proportion of individuals with spots or stripes.

Ecology

Discoglossus pictus occurs from 20 to 2650 m in Morocco and reaches 1000 m in Algeria. In Morocco it lives beside fresh

or saline water and in Algeria in small streams and canals with grass. In Morocco, it is found in areas with permanent water, cisterns, ruins, in *Quercus* forest and *Nerium oleander* scrub. It is active from September through the winter, commonest from February to April. Spends the summer hidden in crevices or under rocks. Its predators include *Natrix maura*, and cannibalism has been reported.

Biology

The males are the first to gather at water. Pairing is at night. In Algeria, egg-laying takes place from early February until late June. The tadpoles reach lengths to 41 mm. At the time of metamorphosis, they measure 10 mm. In Morocco at the end of February, small tadpoles and newly metamorphosed individuals are observed at the same time. The young reach a size of 36 mm in September.

Distribution

Morocco, northern Algeria and Tunisia including Galita Islands (Fig. 10).

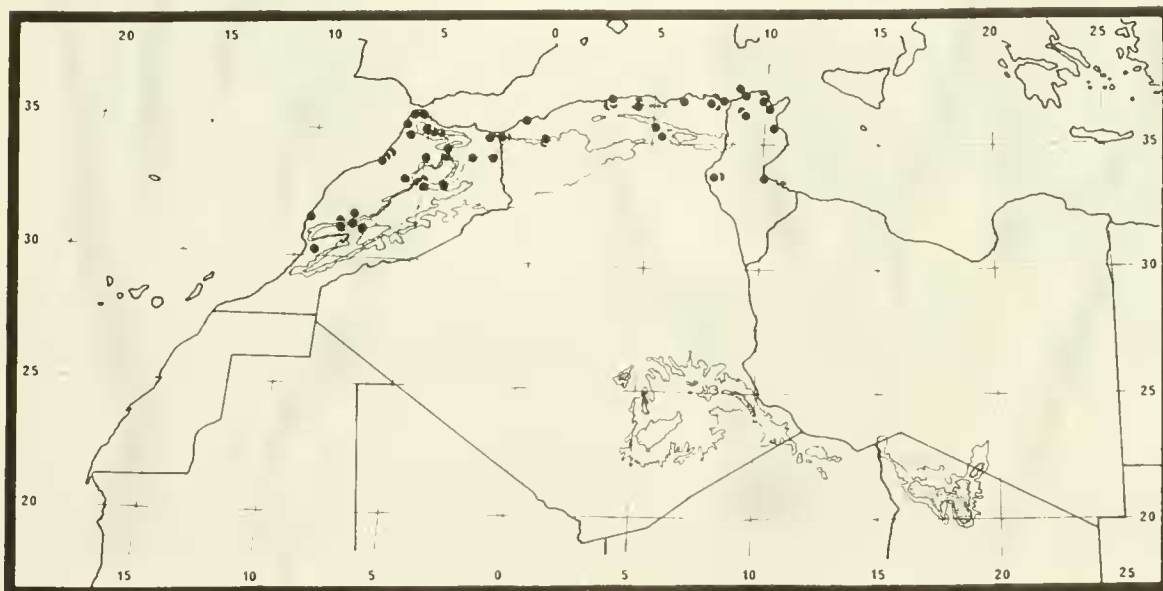


Fig. 10. Distribution of *Discoglossus pictus*.

Bibliography

Busack (1986), Camerano (1878), Capula et al. (1985), Deyrolle (1905), Doumergue (1901), Dubois (1982), Gallien (1948), Heron-Royer (1888, 1891), Lanza et al. (1984), Maxson and Szymura (1984), Malkmus (1981), Pasteur and Bons (1959), Stemmler (1972), Stemmler and Hotz (1972).

Family Pelobatidae

Pelobatid frogs comprise some 90 living species that are found in North America, Europe, Asia, and North Africa. Their pupils are vertical. They are generally burrowers, using their

spade shaped metatarsal tubercles for digging. Usually they lay their eggs in temporary ponds. The species *Pelobates varaldii* lives in North Africa and is endemic to northwestern Morocco.

Pelobates varaldii Pasteur and Bons, 1959 (Figs. 11-12)

Pelobates varaldii Pasteur and Bons, 1959. Trav. Inst. Scient. Cherif. Rabat, Ser. Zool., 17: 117.

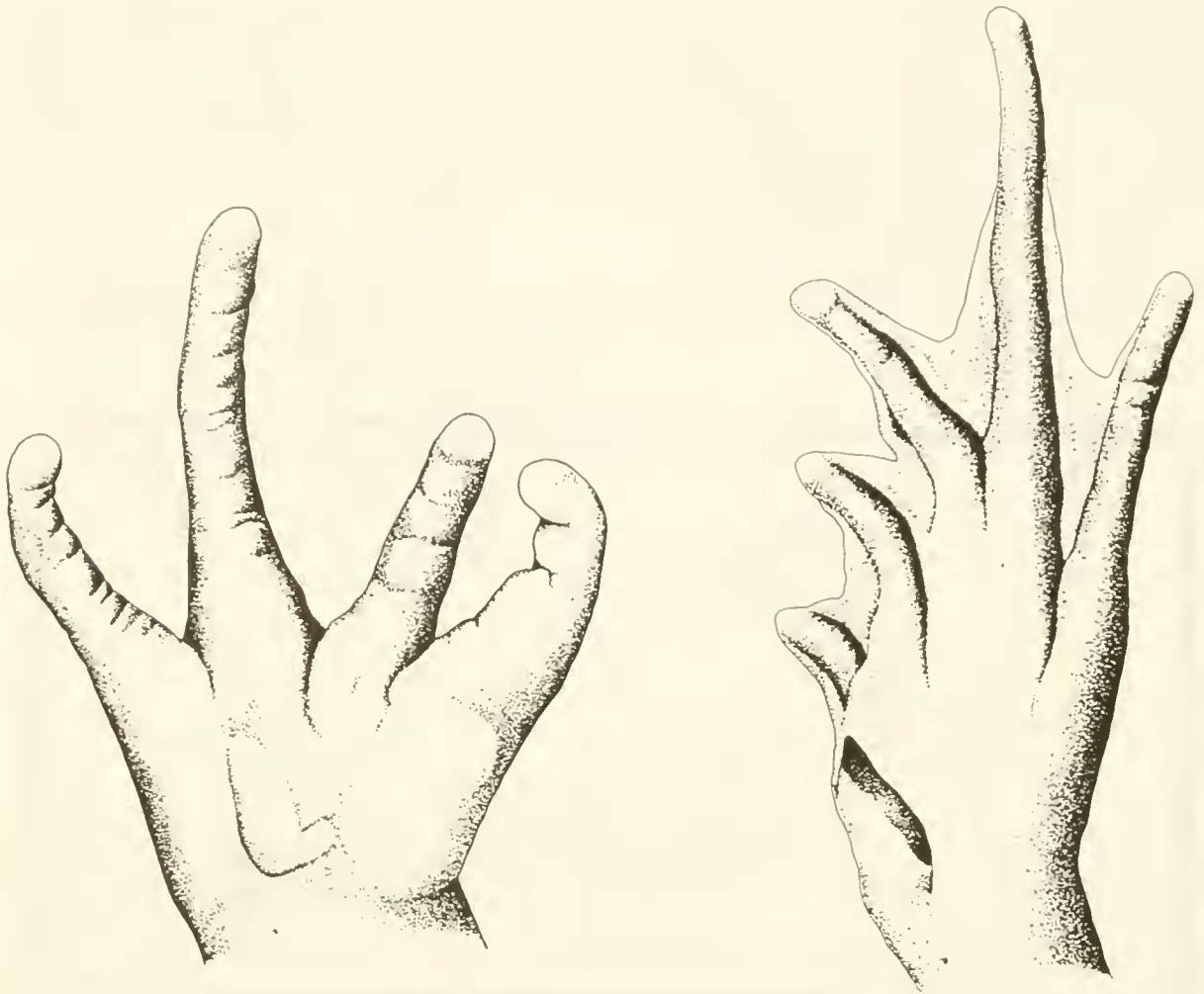


Fig. 11. Palmar view of hand (left) and plantar view of feet (right) of *Pelobates varaldii* (MVZ 162434).

Diagnosis

Toad with smooth skin, no dorsolateral glandular folds and no paratoid glands. Metatarsal spade keratinous. Pupil vertical and tympanum inconspicuous.

Size

Snout-vent lengths to 65 mm in males and 70 mm in females.

Description

Head wide, somewhat concave between eyes. Nostril

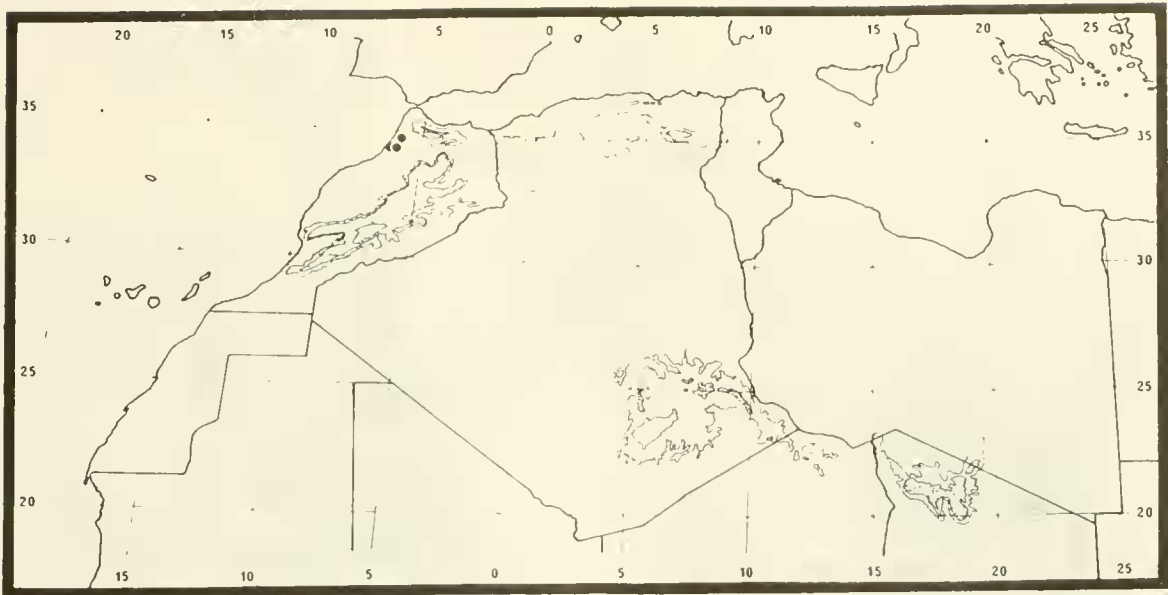


Fig. 12. Distribution of *Pelobates varaldii*.

equidistant between snout and anterior edge of eye. Eyes prominent, their horizontal diameter greater than distance between eye and nostril. Iris yellowish copper or greenish with black spots. Digits with no articular tubercles. Three inconspicuous palmar tubercles. Metatarsal tubercle blackish with whitish base. Skin smooth with small reddish warts on the eyelids and dorsum. Greyish brown dorsum with irregular dark spots. Venter whitish.

Variation

Some individuals have the metatarsal tubercle completely keratinized. Some individuals have red spots on the upper eyelid, but these are absent in other individuals.

Ecology

This toad is nocturnal and only active in autumn and winter. It spends the day buried in the soil and appears to be confined to sandy soils. Its diet is composed of diverse invertebrates.

Biology

Amplexus occurs in the water, and egg-laying takes 5-10 min. It breeds in temporary ponds. The eggs are laid in a string 1-1.5 m long. Eggs are dark grey, and each measure 1.15-2 mm in diameter. The larvae hatch at the latest within a week after laying. The tadpoles feed on plankton and detritus. Tadpoles reach 130 mm length. Metamorphosis takes place in May and June, and the young leave the water with stubby tails. Recently metamorphosed individuals measure 21-34 mm SVL.

Distribution

Plains of northwestern Morocco (Fig. 12).

Bibliography

Busack et al. (1985), Dorda (1984), Pasteur and Bons (1959).

Family Hylidae

An arboreal anuran family, that typically has enlarged pads on the tips of the digits. Hylidae includes some 719 species. The pupil is usually horizontal. The eggs are generally laid in water, although in some tropical species there is parental care. In Africa, there is only one species - *Hyla meridionalis* - which lives in southern Europe, the Canary Islands and Northwest Africa.

Hyla meridionalis Boettger, 1874

(Figs. 13-14)

Hyla arborea var. *meridionalis* Boettger, 1874. Abh. Senck. Naturf. Ges., 9: 186. Boulenger, 1891:159. Pasteur and Bons 1959:168.

Diagnosis

With enlarged discs on the tip of digits. Colour green or yellowish with a small black spot behind the tympanum. Pupil horizontal.

Size

Snout-vent lengths to 46 mm in males and 50 mm in females.

Description

Head wider than high, with round snout. Tympanum conspicuous, its diameter about half eye diameter. Digits with enlarged terminal discs, larger on the fingers than on the toes. Third finger longest and first shortest. The second and fourth of equal length. Forefoot with subarticular tubercles but no palmar tubercles. Hindfoot with oval inner metatarsal tubercle and inconspicuous external tubercle. Skin smooth except on the throat and venter, granular on these areas. Colour yellowish green, sometimes with black spots on dorsum. Venter whitish. Black stripe from nostril to behind tympanum. Iris dark brown. Male with external gular vocal sac.

Variation

Unknown in the area.

Ecology

In Morocco, these frogs are found between 20 and 2650 m, typically in damp meadows, stagnant water, and cultivated fields. In Algeria, their diet consists of dipterans, neuropterans, and lepidopterans. In Morocco, they call nearly year around. After the breeding season, they are arboreal in spring, and their activity decreases towards summer. They are also seen in wet autumns in Algeria.

Biology

At low altitude in Morocco, breeding begins with the first

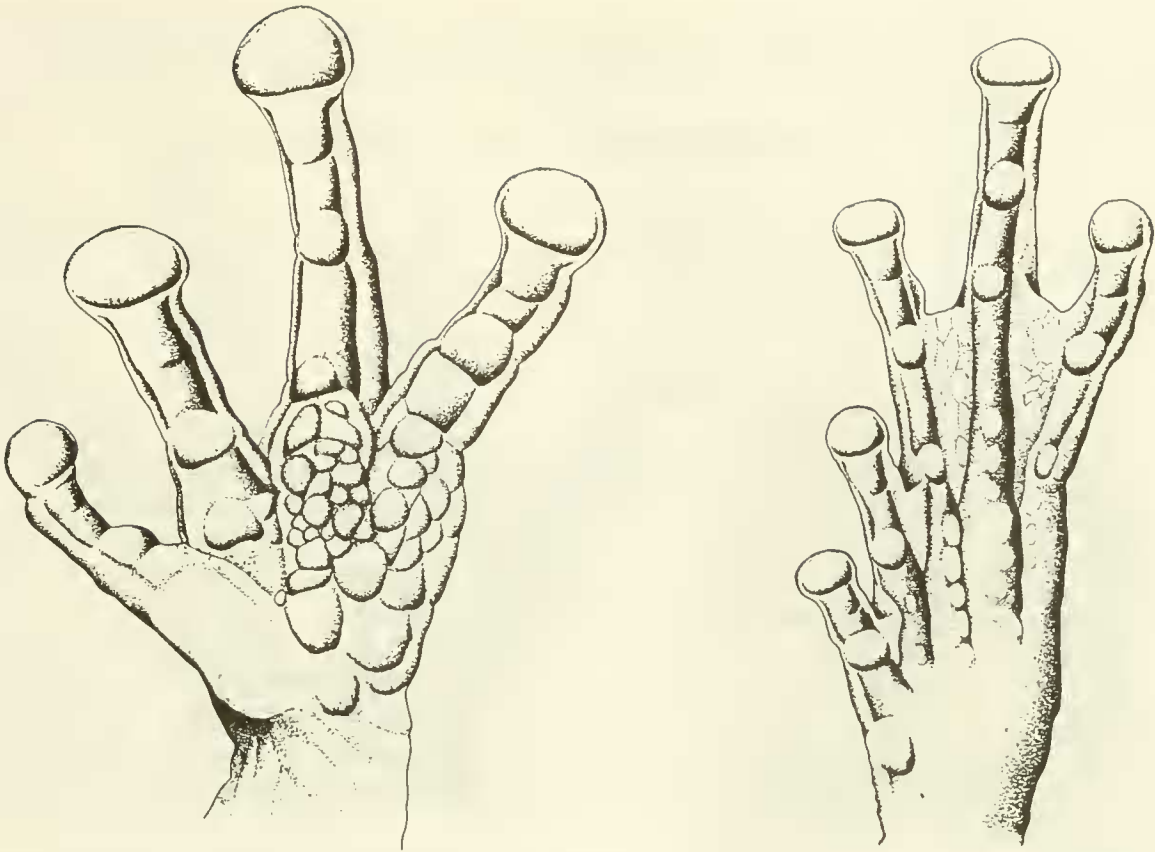


Fig. 13. Palmar view of hand (left) and plantar view of feet (right) of *Hyla meridionalis* (MVZ 186158).

autumn rains in November and continues until April. Males call from February or March until July at 2650 m in the Atlas mountains. Breeding occurs from February to April in Algeria. Most mating takes place at the end of March, and the metamorphosis takes place in May. The migration can be by day.

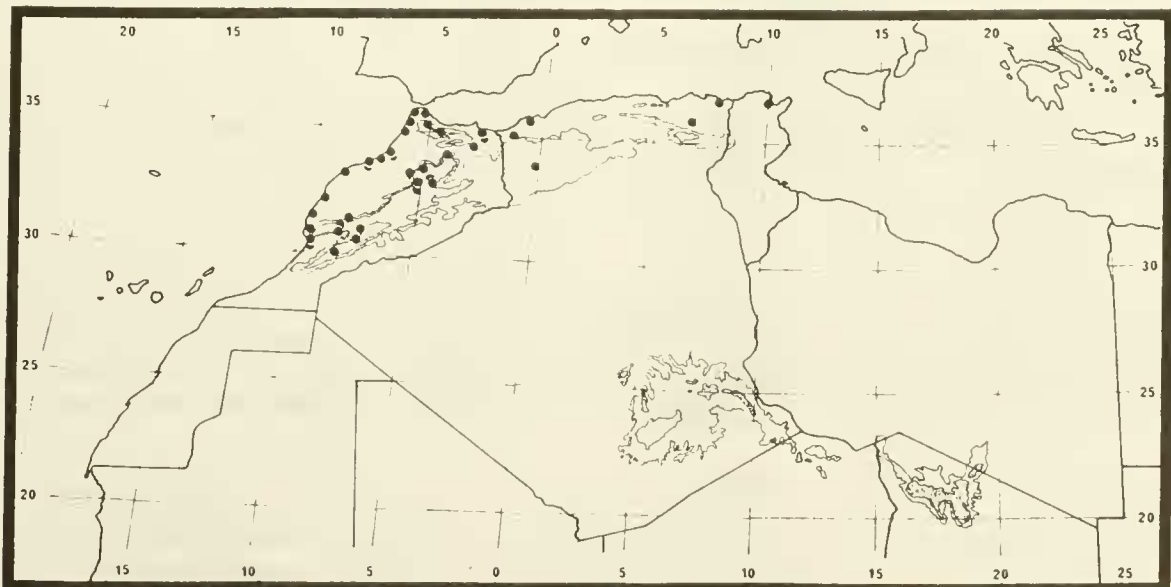


Fig. 14. Distribution of *Hyla meridionalis*.

Egg-laying is at night, and they usually breed in temporary ponds. The tadpoles reach 55 mm total length in Morocco.

Distribution

Morocco, northern Algeria, and northern Tunisia (Fig. 14).

Bibliography

Doumergue (1901), Dubois (1982), Galán (1931), Pasteur and Bons (1959), Stemmler (1972), Stemmler and Hotz (1972), Werner (1931).

Family Bufonidae

This family of true toads encompasses more than 365 living species, with an almost cosmopolitan distribution, absent only from Madagascar and the Australian region. Their skin is usually thick with numerous glands. Most have well developed paratoid glands on head. They are generally terrestrial or digging species. Most produce numerous small eggs.

Two species are endemic in North Africa: *Bufo mauritanicus* and *Bufo brongersmai*. Two widely distributed palaeartic species also live here, *Bufo bufo* and *Bufo viridis*. A species that lives south of the Sahara - *Bufo xeros* - is also present. In addition, *Bufo pentoni*, a sahelian species, occurs nearby and probably occurs here.

Bufo bufo spinosus Daudin, 1803 (Figs. 6d, 15-16)

Bufo vulgaris: Boulenger, 1891:159. Doumergue, 1901:349.

Bufo bufo spinosus: Pasteur and Bons 1959:141.

Diagnosis

Large, uniform dark brown colour, sometimes yellowish toad. Without tarsal folds. Large tubercles present between corner of mouth and paratoid gland. No tibial gland. Distal subarticular tubercle of the fourth toe double. Posteriorly diverging paratoid glands. Small tympanum.

Size

Snout-vent lengths to 110 mm in males and 150 mm in females.

Description

Head very wide, with round snout. Interorbital space flat or somewhat concave. Tympanum conspicuous, its diameter less than half that of eye. Paratoid glands large and elongated diverging at their posterior end. Short digits, third longest; second and fourth of equal length and somewhat shorter than first. Skin warty.

Subarticular tubercles paired in fore and hindlimbs, although in old individuals fused. Two palmar tubercles and two metatarsal tubercles. Colour greyish brown, more or less pale, sometimes with dark patches on dorsum, sometimes yellowish or reddish. Venter yellowish or pale brown. Iris reddish or copper-coloured with black spots.

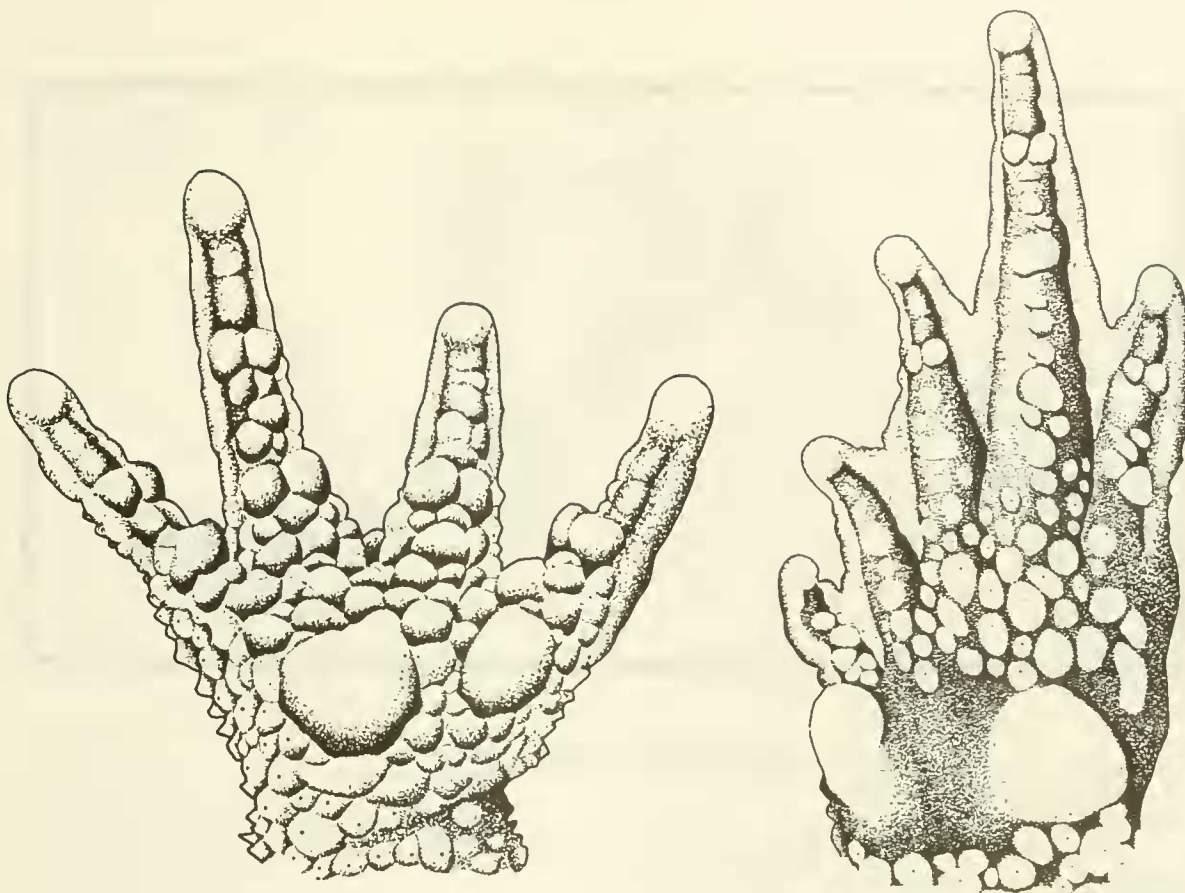


Fig. 15. Palmar view of hand (left, CM 58412) and plantar view of feet (right, MCZ 16244) of *Bufo bufo*.

Variation

The coloration varies between individuals from brown to greyish, greenish, olivaceous, reddish, and mauve. The North African populations are included in the subspecies *spinosus* Daudin, 1803, occurring in southern Europe and characterized by its large size and numerous warts.

Ecology

These toads live in humid areas near to permanent water. They usually live in the mountains of North Africa, although they also occur in the plains in northern Morocco. In the Moroccan Atlas, they reach 2650 m. In Tunisia, they usually live in areas of cork-oak forests. Their diet consist of insects, specially orthopterans.

Biology

Life history data is poorly known for North African populations. At 2650m in the Moroccan Atlas, breeding takes place in spring, because by July only metamorphic or metamorphosed individuals are found.

Distribution

Northern Algeria and northern Tunisia. In Morocco, they occur in the Atlas, Rif, and northwestern plains (Fig. 16).

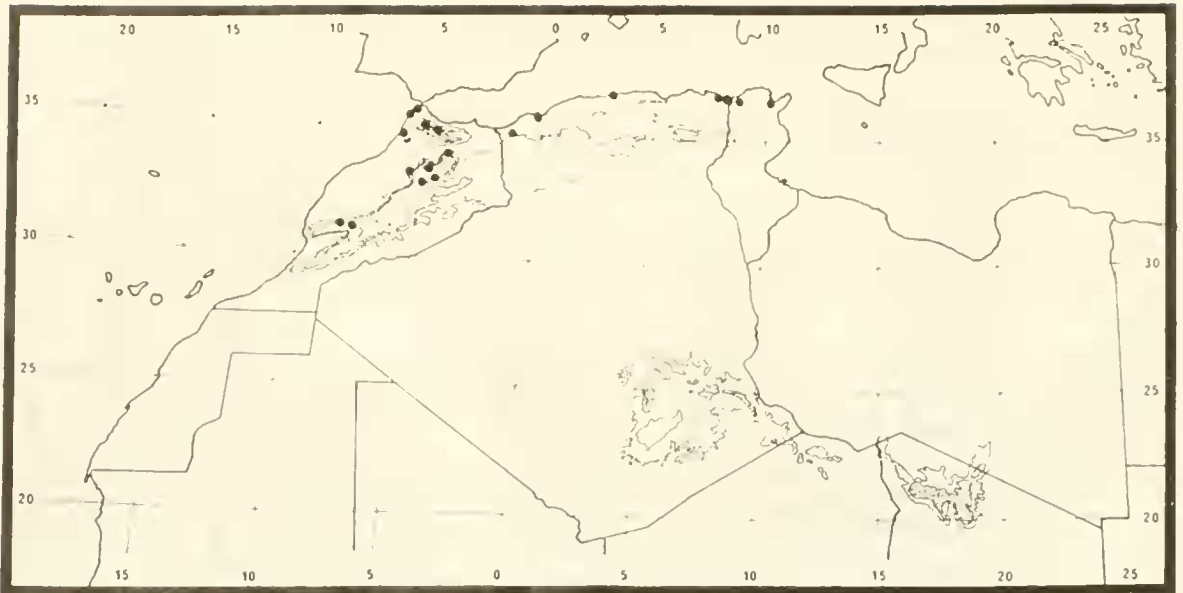


Fig. 16. Distribution of *Bufo bufo*.

Bibliography

Dubois (1982), Pasteur and Bons (1959), Schneider (1974), Stemmler (1972).

Bufo brongersmai Hoogmoed, 1972 (Figs. 6a, 17-18)

Bufo brongersmai Hoogmoed, 1972. Zool. Meded., Leiden, 47: 50.

Diagnosis

Small toad with small green patches on brownish grey dorsum. Pale vertebral line absent. Paratoid glands small, somewhat longer than wide, nearly round. Most distal subarticular tubercle of fourth digit double. No tibial glands. Tympanum nearly round. Head very flat and without warts.

Size

Snout-vent lengths to 51 mm in males and 48 mm in females.

Description

Snout round. Head 2.5 times as long as high. Horizontal diameter of eye is slightly less than distance between eye and snout and 2.5 times horizontal diameter of the tympanum. Interorbital space flat. Subarticular tubercles on digits single except for distal ones often double. Subarticular tubercles on toes single except for double distal one of third and distal two of the fourth.

Dorsum pale brown grey with small green patches and black spots. Paratoid glands, upper eyelids and dorsal warts reddish. Venter white with green spots. Iris green.

Variation

The paratoid glands measure in length 1 to 1.8 times their width. No geographical variation has been described.

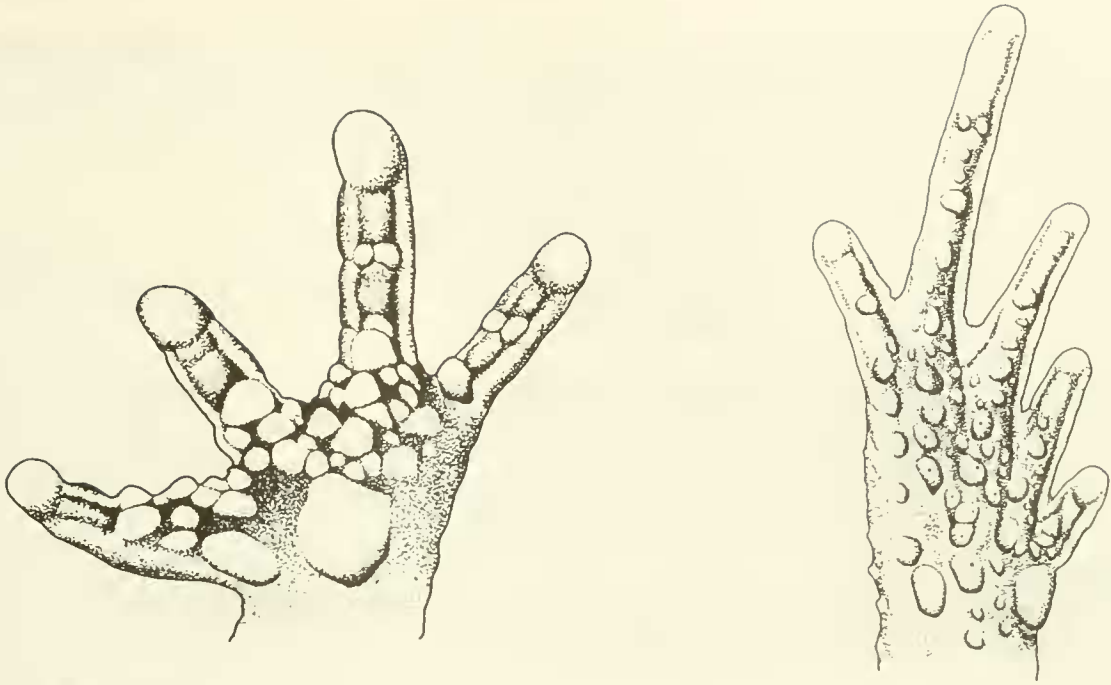


Fig. 17. Palmar view of hand (left) and plantar view of feet (right) of *Bufo brongersmai* (NMW 17221).

Ecology

This species lives in semiarid areas with *Argania*, *Euphorbia*, and graminaceous vegetation. It is found between altitudes of 171 and 1000 m. During the day, individuals rest beneath stones.

Biology

Males have been seen calling in the water in daytime on

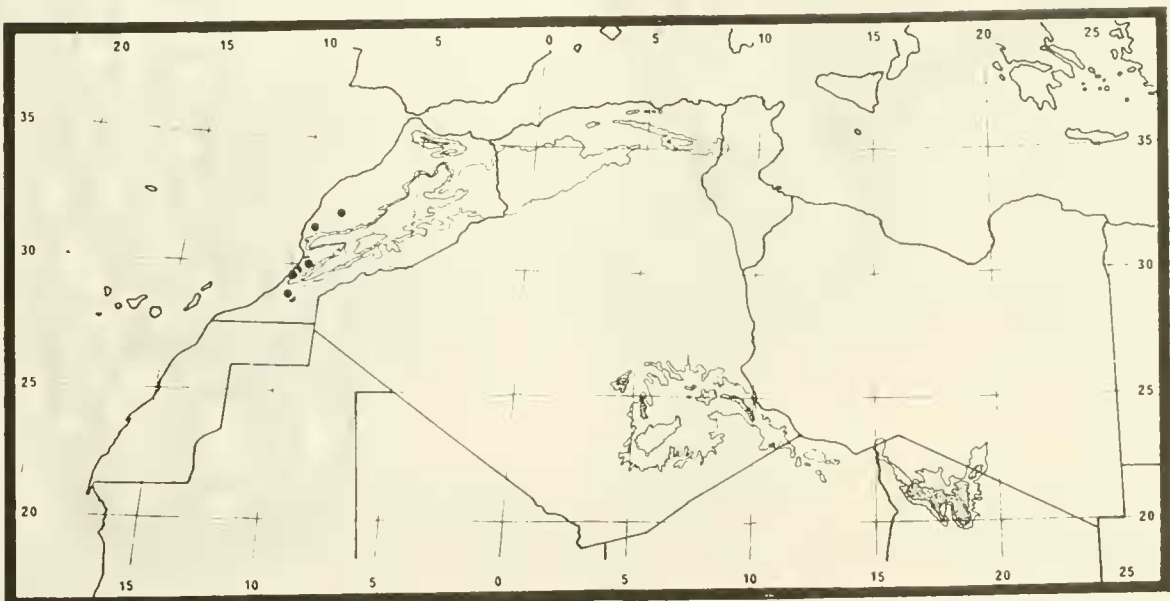


Fig. 18. Distribution of *Bufo brongersmai*.

the 10th of March. On this date, there were already tadpoles measuring 20.9-47.2 mm.

Distribution

Southwestern Morocco (Fig. 18).

Bibliography

De la Riva (1992), Destre et al. (1989), Hoogmoed (1972), Grillitsch et al. (1989).

Bufo mauritanicus Schlegel, 1841 (Figs. 6c, 19-20)

Bufo mauritanicus Schlegel, 1841. In: Wagner, Reisen Algier, 3:134. Boulenger, 1891:158. Pasteur and Bons 1959: 156.

Diagnosis

Large toad with large brown patches bordered with black on

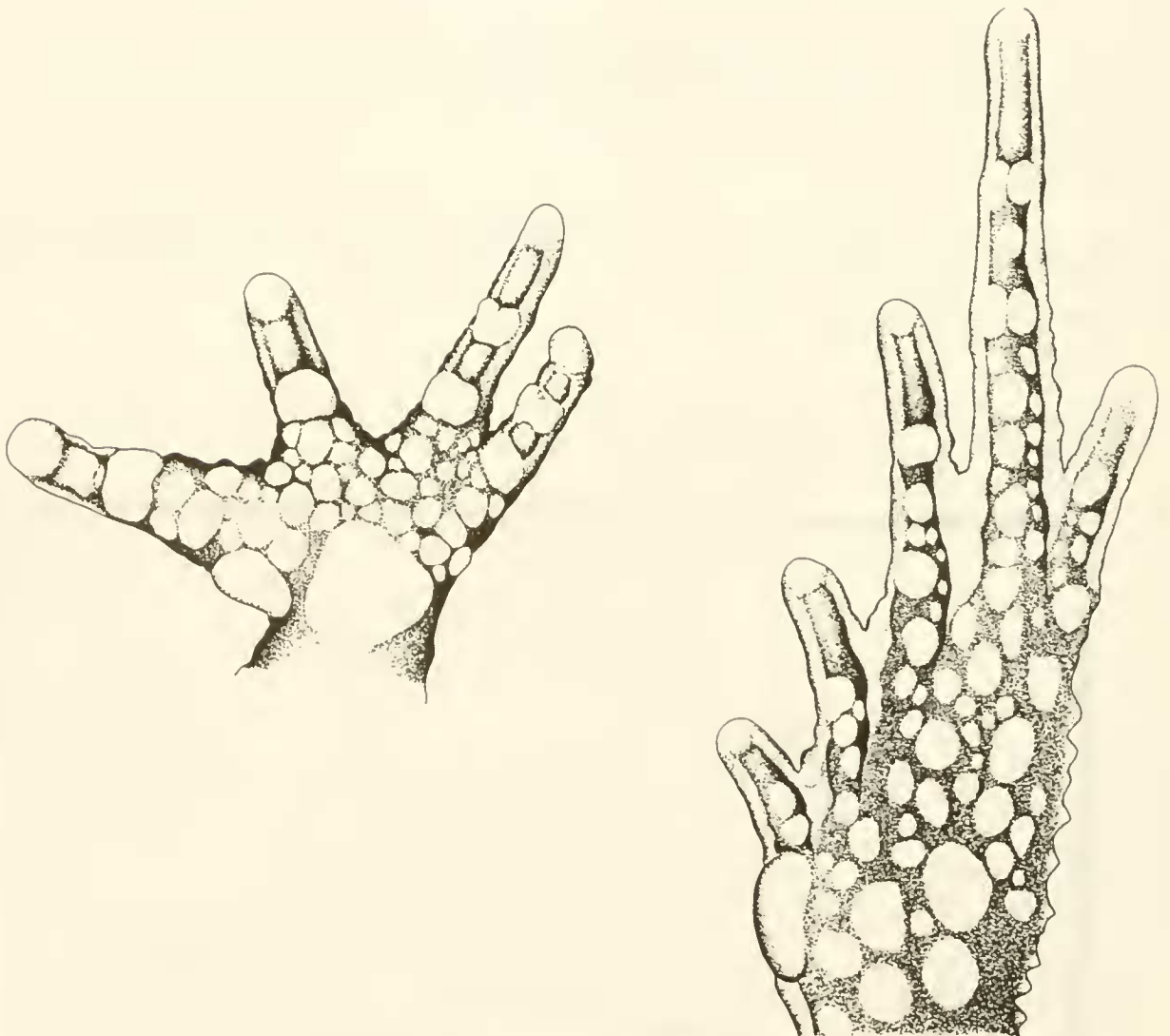


Fig. 19. Palmar view of hand (left, AMNH 103708) and plantar view of feet (right, USNM 196374) of *Bufo mauritanicus*.

the dorsum. Tympanum large and interorbital space concave. Paratoid glands kidney-shaped and parallel. Tarsal fold present. Distal subarticular tubercle on fourth toe double.

Size

Snout-vent lengths to 132 mm in males and 150 mm in females.

Description

Subarticular tubercles, double in young, single in adults. Paratoid glands large and elongated, parallel in young and somewhat divergent posteriorly in adults. Dorsal patches brown to olive, orange, and reddish brown.

Variation

Clinal variation of the dorsal pattern of patches has been described in Morocco and Tunisia. Towards the south the patches tend to disappear and the dorsum becomes an uniform sandy colour.

Ecology

This toad lives in a great variety of habitats, from rocky and stony places with permanent or temporary water, damp meadows, and coastal dunes, to scrub of *Chamaerops humilis*, *Pistacia lentiscus*, and *Olea europaea*. In Morocco, it lives from sea level to 2650 m. During the day, the toads remain beneath rocks or in tunnels. The diet is varied and includes scorpions, although coleopterans dominate.

Biology

They call year around, and day and night. They breed in fresh or brackish water. The breeding period varies depending on region. It might not breed in some years in the pre-Sahara. In Algeria, egg laying lasts from the beginning of April to the middle of May. Isolated laying is recorded in summer. In Morocco, there is an early breeding period in January and another more generalized one in April. However in the Atlas and the Rif mountains, amplexus is delayed until June. Breeding occurs between March and April and July and September in Tunisia. Breeding migrations may be as much as 2 km. Egg laying takes place at night. The eggs are laid in four strings; egg diameter is 1.4-1.7 mm, and they number 5000 to 10000 per female. The larval period lasts some 45 days, and tadpoles do not exceed 30 mm total length. At the time of metamorphosis, they measure 10-12 mm SVL.

Distribution

Morocco, northern Algeria and Tunisia (Fig. 20). Old records in the Adrar mountains (Mauritania), Air (Niger), Hoggar (Algeria), and Tassili N'Ajjer (Algeria) probably result from confusion with *Bufo xeros*.

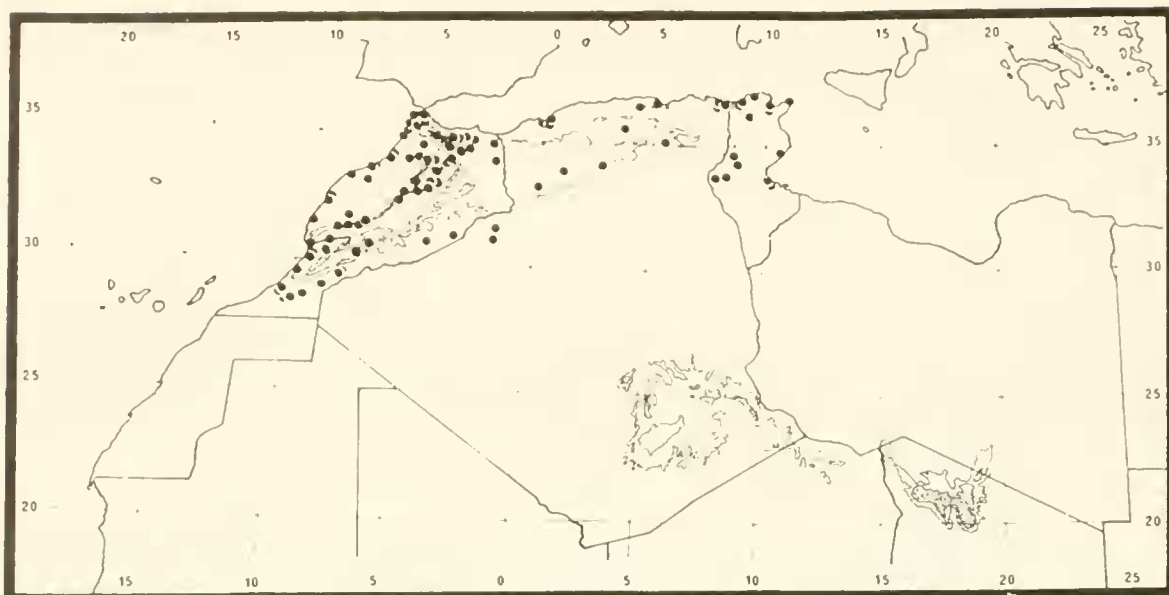


Fig. 20. Distribution of *Bufo mauritanicus*.

Bibliography

Altes and Siboulet (1978), Angel and Lhote (1938), Bellairs and Shute (1954), Cloudsley-Thomson (1974), Doumergue (1901), Dubois (1982), Galán (1931), Malkmus (1981), Meek (1983), Pasteur and Bons (1959), Schneider (1978), Stemmler (1972), Guibé (1950), Dekeyser and Villiers (1956).

Bufo viridis Laurenti, 1768 (Figs. 6b, 21-22)

Bufo boulengeri Lataste, 1879. Rev. Int. Sci.:438.

Bufo viridis: Boulenger, 1891:158. Scortecci, 1936:163. Pasteur and Bons, 1959:149.

Diagnosis

Medium-sized toad, green dorsum with irregular dark patches. Tympanum small. Tarsal fold present. Paratoid glands elongated and parallel. Distal subarticular tubercle of fourth toe single. Tibial gland present. Interorbital region flattened.

Size

Snout-vent lengths to 91 mm in males and 104 mm in females.

Description

Wide head with smooth and narrow interorbital space. Tympanum diameter 0.3-0.5 that of the eye. Short digits. Subarticular tubercles of fore- and hindlimbs single. Two palmar and two metatarsal tubercles. Dorsal patches are reddish brown in young and dark green in adults; patches bordered with black or with no dark border. Iris metallic greenish yellow spotted with black. Belly whitish, with small blackish spots.

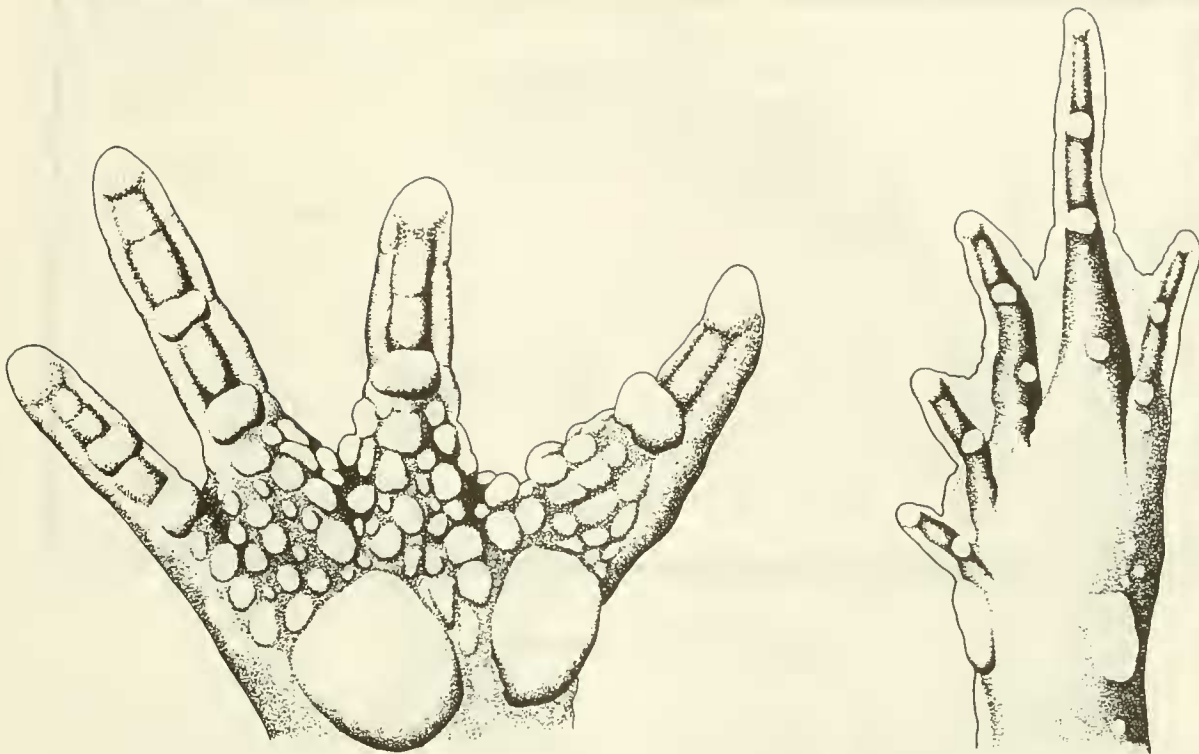


Fig. 21. Palmar view of hand (left, AMNH 52838) and plantar view of feet (right, USNM 195279) of *Bufo viridis*.

Variation

The populations of Morocco, Algeria and western Libya have a pale vertebral line, a relatively short tibia, and relatively short tibial and paratoid glands. The taxon *boulengeri* Lataste, 1879 can be applied to these populations. Populations of Algerian Sahara have the smallest SVL in North Africa.

Ecology

These toads live in open areas and takes refuge in burrows or beneath rocks. In Algeria, they are active year around and in Libya from March to December. In Morocco, they reach 2300 m in *Cedrus atlantica* forest. In arid Saharan areas, they occur in the vicinity of oases. In the Hoggar mountains, they live at 1400-2500 m next to permanent streams. They eat snails, worms, and insects, specially coleopterans. In Libya, densities of 113 individuals per hectare have been estimated in gardens and cultivated fields.

Biology

In North Africa, they usually breeds from February to May. Another breeding period, August to September is also recorded in Tunisia. After rains, they breed in any season in the Hoggar mountains; amplexus was observed in April, June, and August. Tadpoles have been found in September. In Libya, laying takes place from the end of February to the end of April, although amplexus has also been seen in September and tadpoles in January.

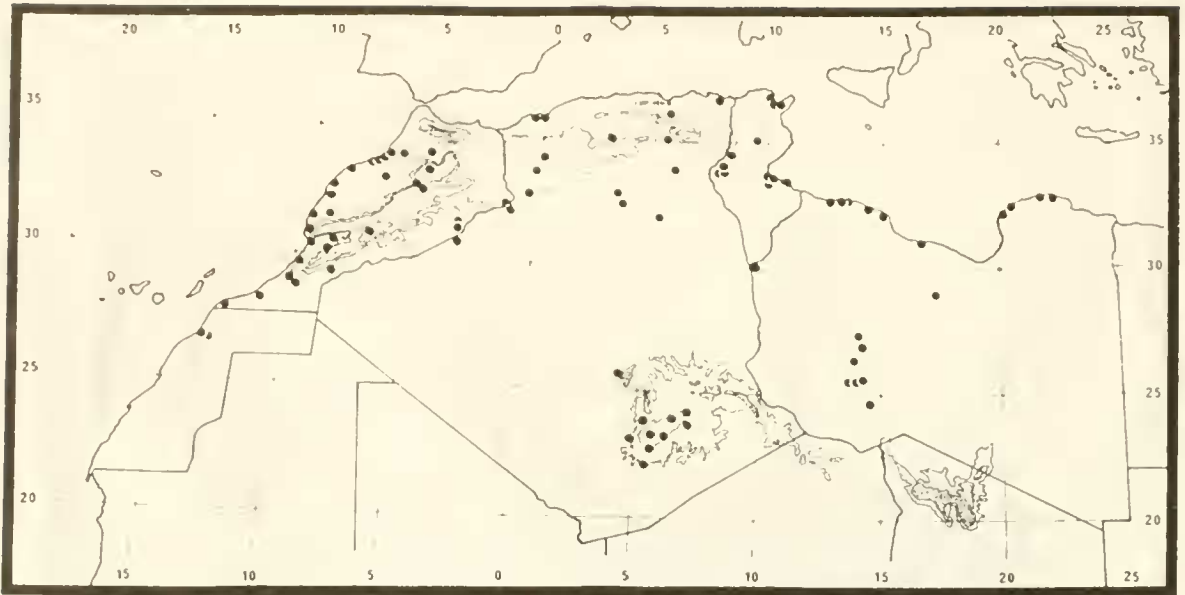


Fig. 22. Distribution of *Bufo viridis*.

During the breeding season, green toads are aquatic and active by day. The eggs are arranged in two strings. The tadpole reaches 62 mm total length and measures 15-20 mm SVL at the time of metamorphosis. In Libya, tadpoles have been observed making cup depressions at the bottom of pools.

Distribution

Morocco, north of western Sahara, Algeria, Tunisia, and Libya (Fig. 22).

Bibliography

Angel (1944), Angel and Lhote (1938), Blanc and Nouira (1988), Boulenger (1891), Doumergue (1901), García París and López Jurado (1990), Grover (1971), Hoogmoed (1972), Mertens (1929), Pasteur and Bons (1959), Pellegrin (1927, 1934), Scortecci (1936), Schleich (1987), Schnurrenberger (1962), Stemmler and Hotz (1972), Werner (1914), Zavattari (1934).

Bufo xeros Tandy, Tandy and Duff-MacKay, 1976 Figs. 6e, 23-24)

Bufo regularis: Scortecci, 1936:143.

Bufo xeros Tandy, Tandy and Duff-Mackay, 1976. Pearce-Sellards Ser., Texas Mem. Mus., 24: 3.

Diagnosis

Toad with elongated, narrow and diverging paratoid glands. Tympanum relatively large and rounded. Tarsal fold present. Subarticular tubercles single. Yellowish brown colour with reddish spots in the posterior femoral region. Six pairs of dark, nearly rectangular spots on the head and dorsum.

Size

Snout-vent lengths to 82 mm in males and 97 mm in females.

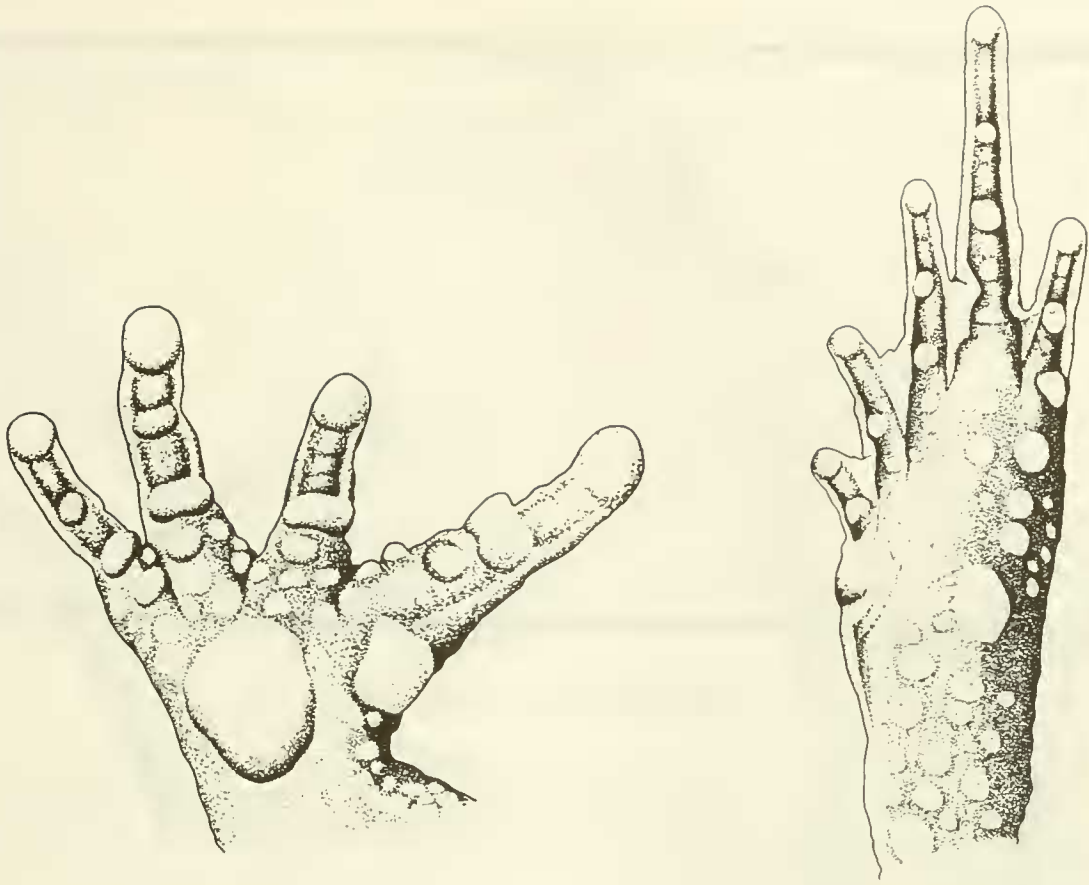


Fig. 23. Palmar view of hand (left) and plantar view of feet (right) of *Bufo xeros* (CAS 138523).

Description

Head longer than wide. Tympanum vertically oval, its horizontal diameter 0.6 times that of eye. Paratoid glands elongated and narrow, divergent at the extremes. Subarticular tubercles wide, usually single, occasionally double. Forelimb with elongated gland on posterior surface. Tarsal fold well developed. Upperparts olivaceous brown, greyish or yellowish, with six pairs of dark brown spots on the head and dorsum. Paratoid glands are yellowish. Belly cream coloured, greyish brown on the throat of males.

Variation

Outside the North Africa, geographical variation in call, size and colouration has been recognized. No nominal taxon has been described within the area, and no subspecies are currently recognized.

Ecology

Individuals observed active from September to March. Their diet is composed of arachnids and insects, specially coleopterans. They are active at night, and in the breeding season, they are also active during the day. They are found in oases and in pools of water for livestock.

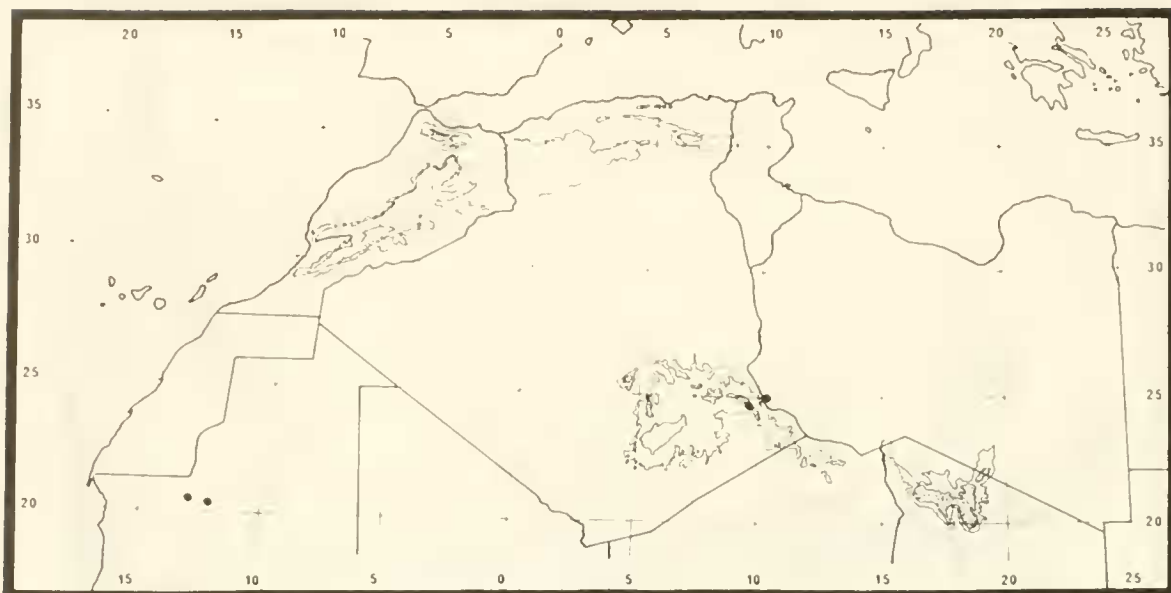


Fig. 24. Distribution of *Bufo xeros*.

Biology

They breeds in September-October and February-March. The tadpole reaches 34 mm total length. Metamorphosed individuals measure 10.5-15 mm SVL.

Distribution

A species of semiarid regions south of the Sahara, also found in the mountains of Hoggar (Algeria), Air (Niger), and Adrar (Mauritania) (Fig. 24).

Bibliography

Angel (1944), Angel and Lhote (1938), Dekeyser and Villiers (1956), Joger (1981), Guibé (1950), Lavauden (1926), Scortecci (1936), Siboulet (1969), Tandy et al. (1976).

Bufo pentoni Anderson, 1893 (Figs. 6f, 25-26)

Bufo pentoni Anderson, 1893. Ann. Mag. Nat. Hist., (6) 12: 440.

Diagnosis

Small, brownish coloured toad. Paratoid glands conspicuous, nearly parallel, somewhat separated posteriorly. Tympanum higher than wide. Three very conspicuous digging tubercles, one tarsal and two metatarsal.

Size

Snout-vent lengths to 64 mm in males and 75 mm in females.

Description

With large central palmar tubercle and another reduced one on first finger. Subarticular tubercles single except doubled distal one of fourth finger. Breeding male with conspicuous

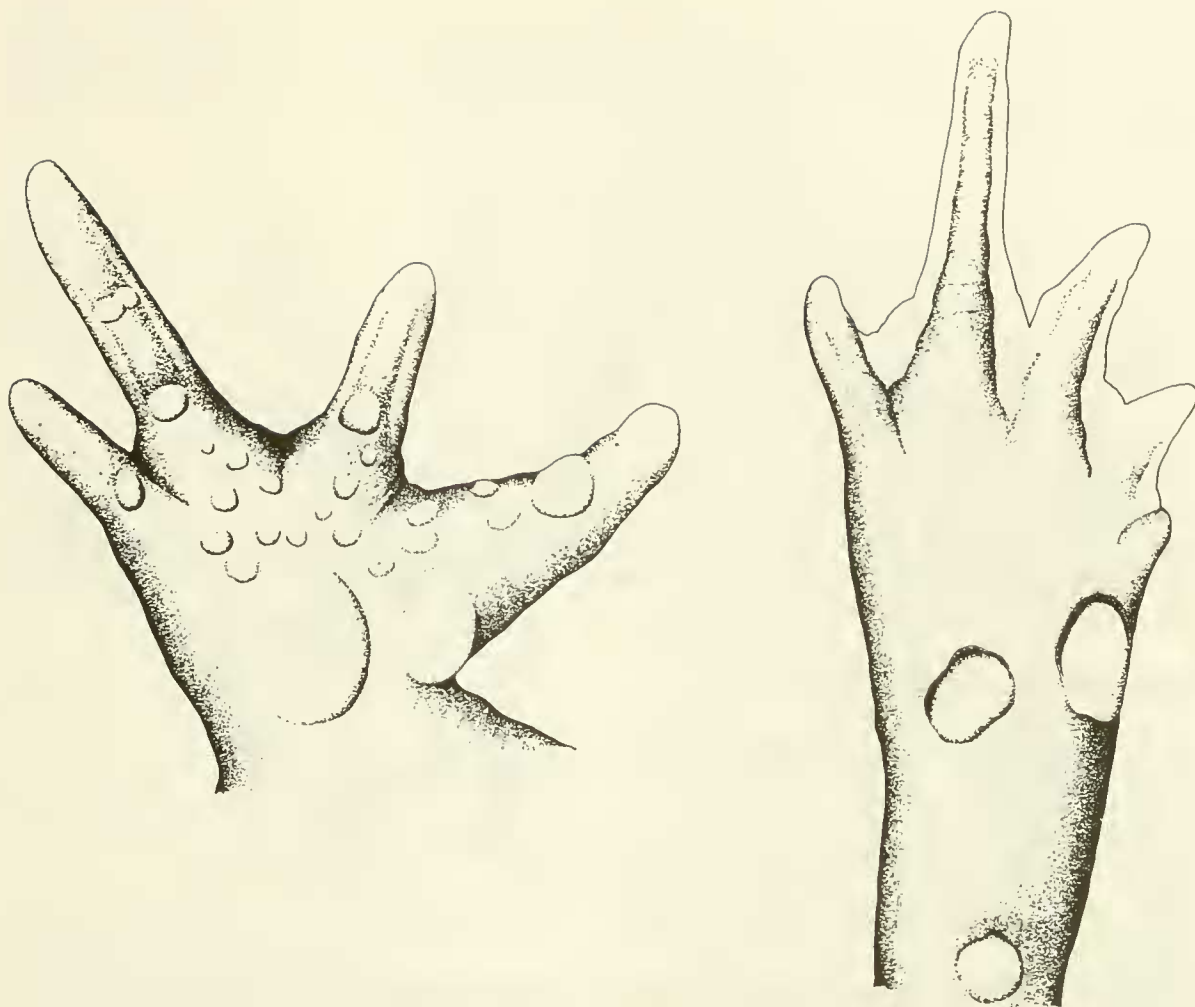


Fig. 25. Palmar view of hand (left) and plantar view of feet (right) of *Bufo pentoni* (BM 1913.5.9.79).

spines on the warts. Dorsum brown, usually pale. Venter whitish. Dark spots usually evident on back of juveniles.

Ecology

They breed in temporary pools that form with the first rains of summer. They aestivate for very long periods.

Biology

They reach sexual maturity at two years old, and can live at least six years. During the first two years, growth is rapid and later very slow. In the first months after metamorphosis, individuals grow at a daily rate of 0.53 mm. The survival of larvae and young is low and varies from one year to another. The age structure is heterogeneous, probable due to the annual variability in recruitment.

Distribution

South of the Sahara from Mauritania to Ethiopia and Arabia. Also in the Sahara, at the Trarza region (Mauritania), and Air mountains (Niger).

Bibliography

Balletto and Cherchi (1973), Barbault et al. (1979), Forge and Barbault (1977), Francillon et al. (1984), Guibé (1950), Joger (1981).

Family Ranidae

A large anuran family containing more than 625 species that live on every continent. For the most part, they are aquatic and have long hindlimbs with extensive webs. They usually deposit their eggs in still waters.

In North Africa, *Rana saharica* is an endemic species. Eastern Libyan records of *R. saharica* could belong to *Rana levantina* Schneider, Sinsch, and Nevo 1992, recorded from the Nile delta. Two Ethiopian species also live in the area: *Hoplobatrachus occipitalis* and *Tomopterna cryptotis*. The first has the appearance of a frog and is aquatic whereas the second resembles a toad and is fossorial.

Rana saharica Boulenger, 1913 (Figs. 27-28)

Rana esculenta: Boulenger, 1891:157.

Rana esculenta var. *saharica* Boulenger, 1913. Novit. Zool., 20:84.

Rana esculenta ridibunda: Doumergue, 1901:332. Scortecci, 1936:131. Pasteur and Bons 1959:188.

Rana zavattarii Scortecci, 1936. Atti Soc. Ital. Sci. Nat., 75:135.

Rana ridibunda riodeoroi Salvador and Peris, 1975. Bol. Est. Centr. Ecol., 8:49.

Diagnosis

Frog with dorsolateral glandular folds and strongly webbed hindfeet. Single subarticular tubercles.

Size

Snout-vent lengths to 86 mm in males and to 105 mm in females.

Description

Head as wide as long, with oval snout. Eyes big and projecting, dorsally placed. Tympanum circular, with diameter 0.7-0.9 that of the eye. Adpressed hindlimb to tympanum or snout. Internal metatarsal tubercle on heel, not projecting beyond base of first toe. Sometimes there is a small tarsal tubercle on the prolongation of the fourth toe. Subarticular tubercles small and single. Webbing between toes. Skin shiny; dorsum somewhat warty, venter smooth. Glandular dorsolateral fold well-developed. Coloration variable; dorsum green, brown, or grey; dark spots on dorsum and limbs. Venter whitish with dark spots. Iris yellowish copper or metallic yellowish green.

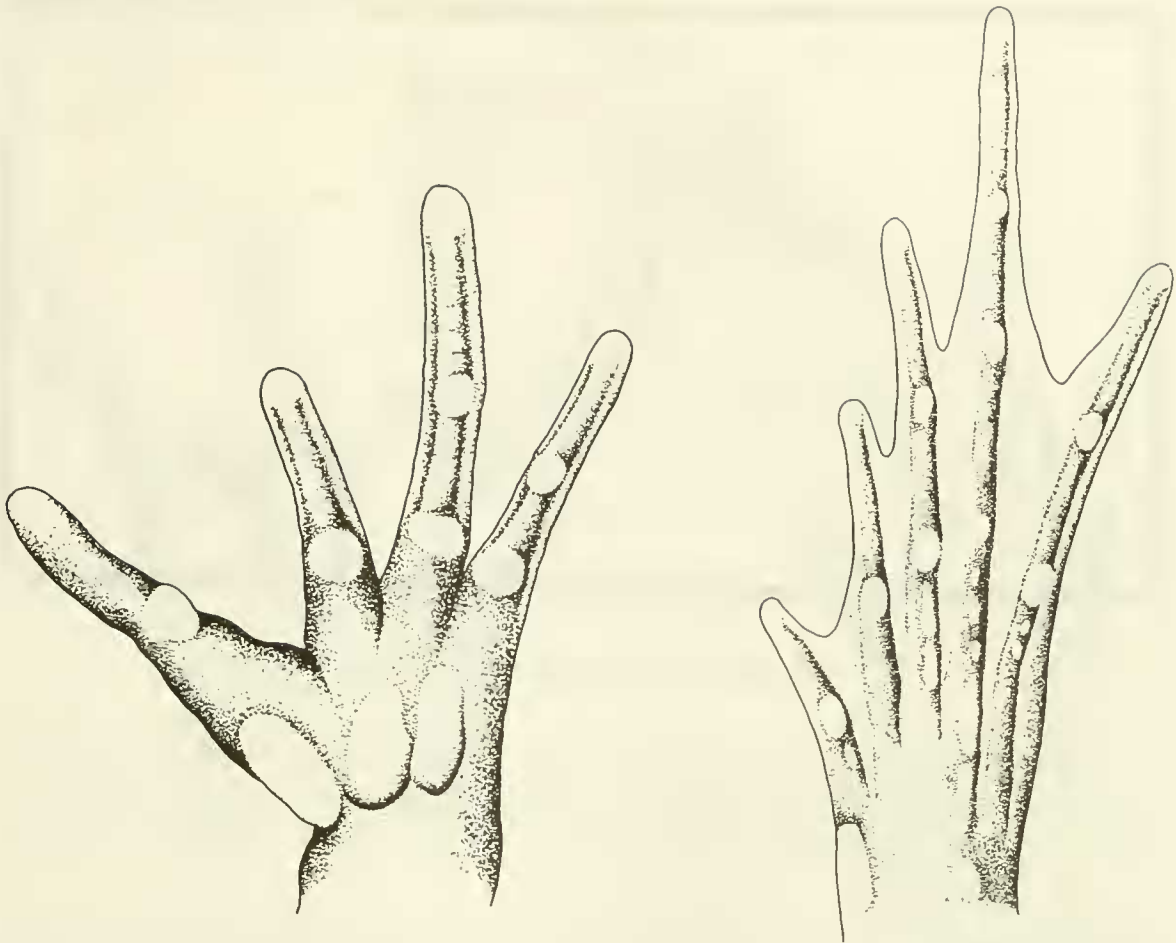


Fig. 27. Palmar view of hand (left) and plantar view of feet (right) of *Rana saharica* (LACM 108988).

Variation

The dorsal pattern and size show geographical variation. The Saharan populations usually lack a pale vertebral line and their coloration is greyish brown. Size (SVL) decreases southward.

Ecology

This is an aquatic species, living in irrigation ditches, ponds, springs, rivers, and temporary pools. It occurs from 20 to 1700 m in Morocco. In the northern Algeria and Morocco, the young are active by February, the adults in April. Their diet in Algeria is composed of insects, tadpoles, fish, and fish eggs. The predation of *Hyla meridionalis* by this species has been reported.

Biology

Amplexus occurs in May (western Sahara) or June (Algeria). Tadpoles reach 70 mm total length (Morocco). If they overwinter, they reach 100 mm. The individuals that metamorphose in the year in which they hatch measure 12-14 mm SVL. Those that metamorphose the following year measure 20 mm SVL.

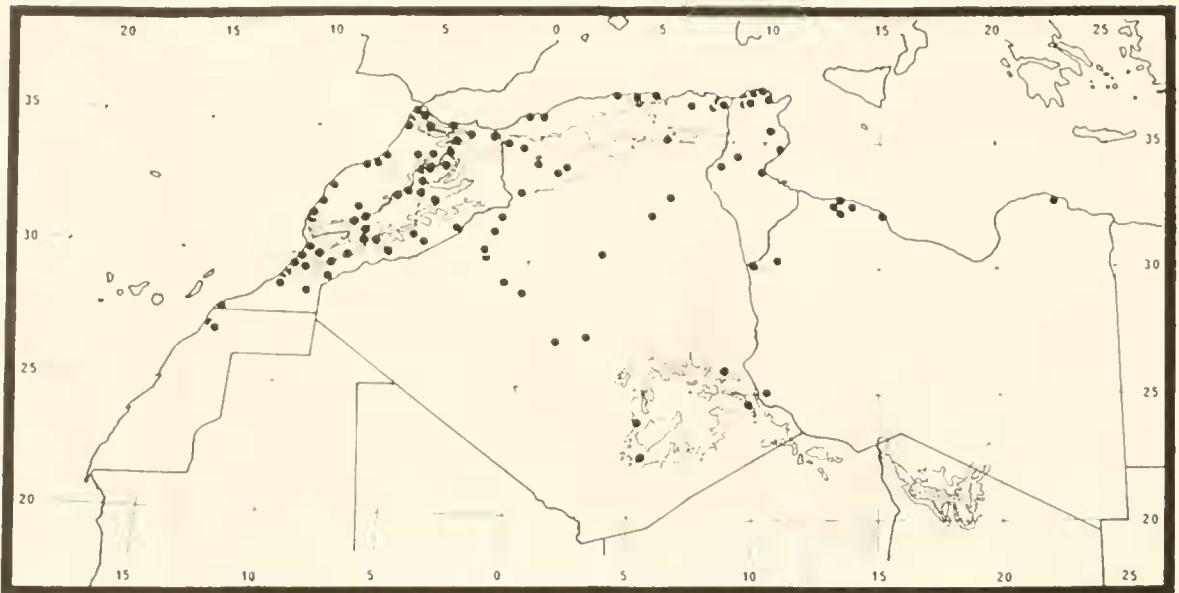


Fig. 28. Distribution of *Rana saharica*.

Distribution

North of western Sahara, Morocco, Algeria, Tunisia, and Libya. In the northern Sahara, their presence is limited to oases. They are also found in the mountains of Hoggar (Algeria) and Tassili N'Ajjer (Algeria) (Fig. 28).

Bibliography

Angel and Lhote (1938), Böhme (1978a), Doumergue (1901), Eiselt and Schmidtler (1973), Foley (1935), Grover (1971), Hartert (1913), Hemmer et al. (1980), Meek (1983), Pasteur and Bons (1959), Pellegrin (1931, 1934), Salvador and Peris (1975), Scortecci (1936), Schleich (1987), Steinwarz and Schneider (1991), Stemmler (1972), Stemmler and Hotz (1972), Uzzell (1982), Zavattari (1934).

Hoplobatrachus occipitalis (Gunther, 1859) (Figs. 29-30)

Rana occipitalis: Scortecci, 1936:139.

Rana tigrina occipitalis: Dekeyser and Villiers, 1956:40.

Hoplobatrachus occipitalis: Dubois, 1992:315.

Diagnosis

Large frog without dorsolateral glandular folds and with scattered warts on dorsum and flanks. Extensive webbing on hindfeet, including beyond the first and last toe. Only one subarticular tubercle at base of fingers; two or more subarticular tubercles on hindfeet. Single inner metatarsal tubercle. Pale occipital patch contacting eyes from behind.

Size

Snout-vent lengths to 85 mm in males and to 115 mm in females.

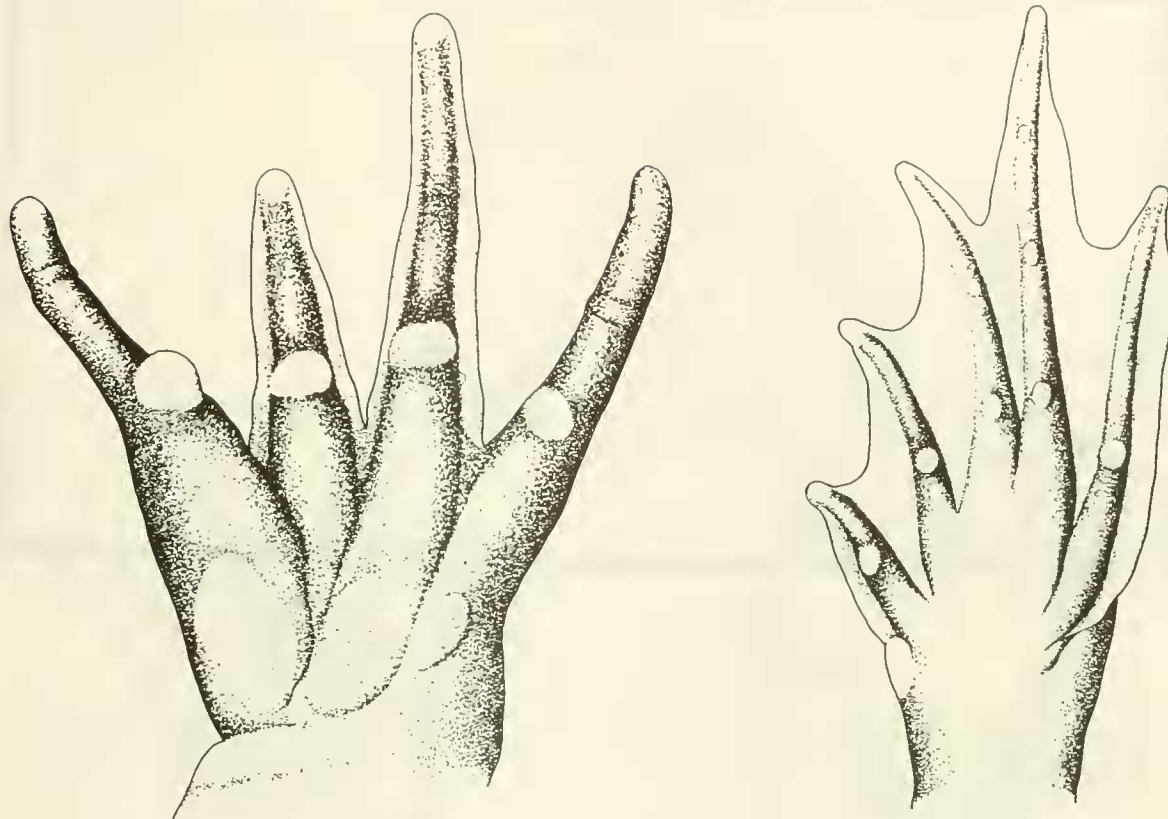


Fig 29. Palmar view of hand (left) and plantar view of feet (right) of *Hoplobatrachus occipitalis* (MZUF 16466).

Description

Large frog. Head very broad with dorsal eyes. Tympanum round with diameter about equal to horizontal diameter of eye. Forelimbs short; third digit longest and second the shortest, first and fourth digits subequal. One tubercle at base of each finger. Distinct palmar tubercle on first finger. Large hindlegs, with extensive webbing between and even outside toes. One or more subarticular tubercles on each digit. Single, large metatarsal tubercle.

Pupil rhomboidal. Iris blackish golden with reddish dots. Dorsum brilliant green or brownish. Flanks yellowish and belly whitish. Lips yellow or red with green or black transverse bars. Dorsum with irregular brownish or green spots outlined in black; some scattered yellow spots. Black postocular stripe from eye to corner of mouth. Venter spotted with greenish brown.

Variation

Northern specimens are larger and paler.

Ecology

In North Africa, *H. occipitalis* is found in oases in mountainous regions, where it lives in wells and cisterns. Active by day and night. They feed on coleopterans and

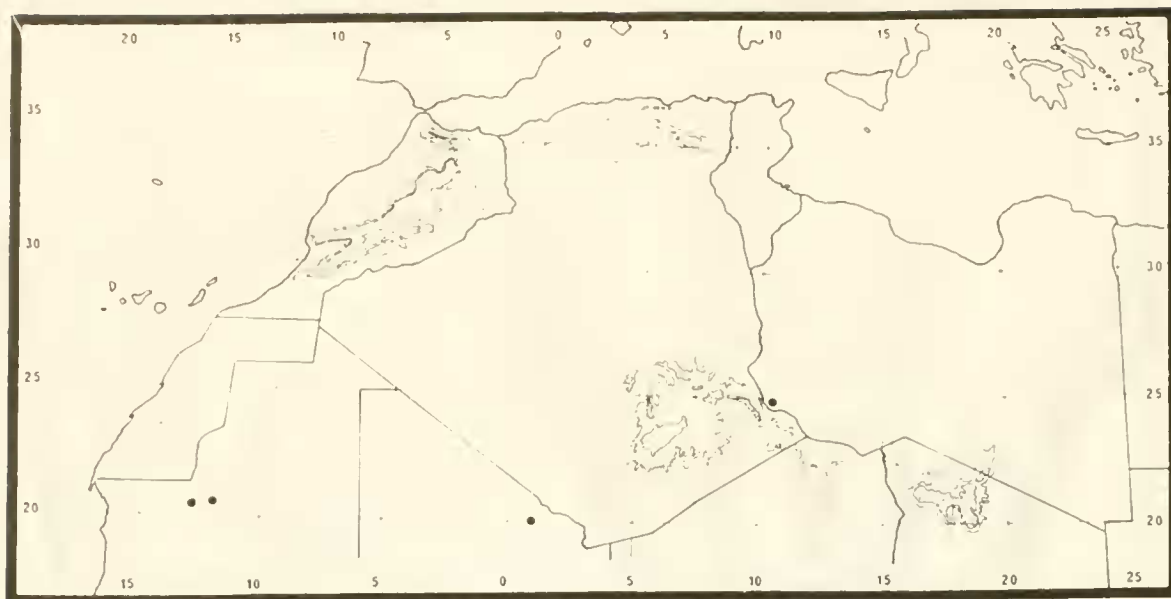


Fig. 30. Distribution of *Hoplobatrachus occipitalis*.

orthopterans, toads (*Bufo xeros*) and their tadpoles, and even individuals of their own species. During winter, they are inactive.

Biology

The call is a prolonged mooring. They are very active in September-October during which breeding seems to occur. In Senegal, they are sexually inactive during the dry season.

Distribution

An Ethiopian species, occupying isolated enclaves in northwestern Africa: southwestern Libya, Adrar (Mauritania), Adrar des Iforas (Mali), and Air mountains (Niger) (Fig. 30).

Bibliography

Angel and Lhote (1938), Böhme (1978a, 1978b), Dekeyser and Villiers (1956), Joger (1981), Micha (1975), Lamotte and Zuber-Vogeli (1954), Scortecci (1936).

Tomopterna cryptotis (Boulenger, 1907) (Figs. 31-32)

Pyxicephalus delalandii: Guibé, 1950:330.

Pyxicephalus sp.: Dekeyser and Villiers, 1956:40.

Diagnosis

Toad-like but without paratoid glands. Pupil horizontal. Large inner metatarsal tubercle for digging. Generally with three pale longitudinal lines on the dorsum.

Size

Snout-vent lengths to 64 mm.



Fig. 31. Palmar view of hand (left) and plantar view of feet (right) of *Tomopterna cryptotis* (BM 1975.2445).

Description

Body plump. Head wide and round snout. Dorsum and flanks covered with small round warts. Belly smooth. Snout short with nostrils nearly at its tip and well separated. Tympanum generally indistinct, in some individuals visible and measures half the diameter of the eye. Fingers without webs and reduced webbing between the toes. Subarticular tubercles single and conspicuous. Three palmar tubercles. Small external metatarsal tubercle, larger than toe nearest to it.

Colour variable, from grey to olivaceous brown. Dark patch between eyes and three longitudinal pale patches on dorsum. Coloration of young similar to adults, green dorsum with yellow vertebral stripe. Dark spot on each side of snout. Breeding males with keratinized ridges on first and second finger.

Variation

Unknown.

Ecology

Unknown for North Africa. Apparently, they spend the day buried in ground and comes out on damp or rainy nights. When disturbed, they inflate their body.

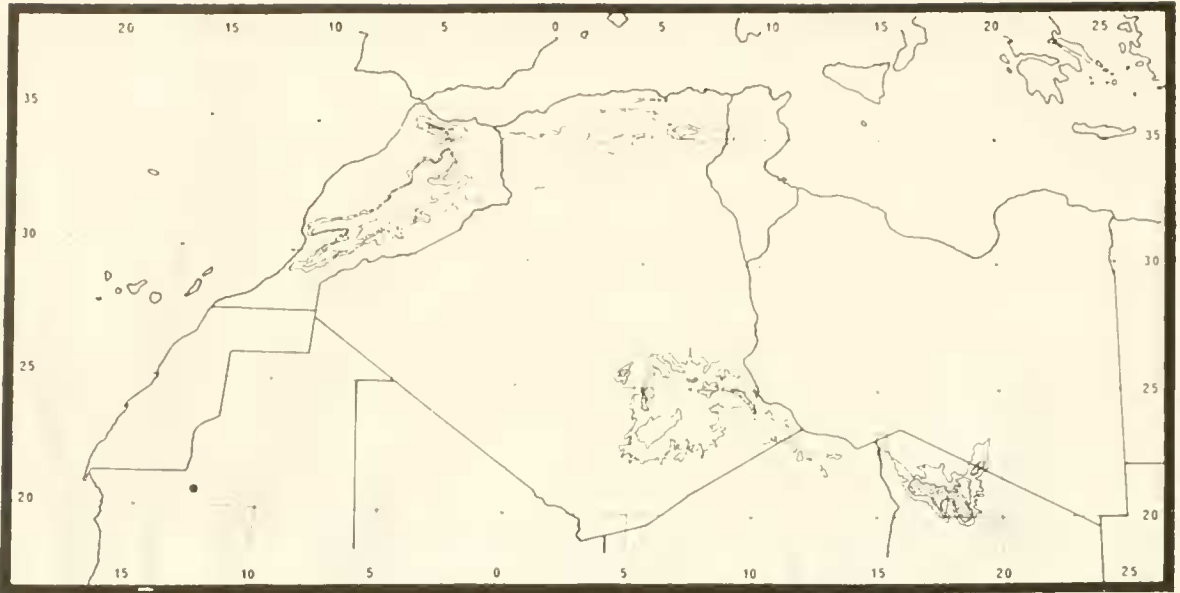


Fig. 32. Distribution of *Tomopterna cryptotis*.

Biology

Unknown for North Africa. They call at night during the breeding season, which in South Africa lasts from October to May. The calling males congregate in shallow pools. Eggs diameter measure 1.5 mm, and the capsule that envelops it is 3 mm. The tadpoles hatch after three days and hide in the mud. They reach a size of 39 mm total length. Metamorphosis takes place at five weeks at a size of some 12 mm SVL.

Distribution

Ethiopian species, in the Sahara confined to the mountains of Adrar (Mauritania) and Air (Niger) (Fig. 32).

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